Review for Influence of 5G on Industry Internet

Yang Liu[1,2,3,4(✉)], Liang-Jie Zhang[3,4], and Chunxiao Xing[1,2]

[1] Research Institute of Information Technology Beijing National Research, Center for Information Science and Technology, Tsinghua University, Beijing 100084, China
1491701161@qq.com

[2] Department of Computer Science and Technology Institute of Internet Industry, Tsinghua University, Beijing 100084, China

[3] National Engineering Research Center for Supporting Software of Enterprise Internet Services, Shenzhen 518057, China

[4] Kingdee Research, Kingdee International Software Group Company Limited, Shenzhen 518057, China

Abstract. In recent year, the downward pressure on the global economy is increasing, and the market is gradually changing. The urgent problem for entrepreneurs is how to keep their companies growing continuously. Industry Internet is a new direction that can help them by promoting business growth of enterprises. And the growth should be realized by exploring innovative business scenarios. The core of industry internet is not the internet, but the traditional industry. It forms the industry value chain through the mutual connection of traditional industries. The enterprises in each link of the value chain will become more powerful because of their value-added data. This paper solves several key problems in the development of enterprises: what economic era are they in? What is industry internet? How does industry Internet empower enterprises? How can 5G related technologies help traditional industries transform into industry internet?

Keywords: 5G · Industry internet · Digital economy · Business scenario

1 Introduction

Industry Internet is an industry ecology formed by remolding and transforming the industrial chain and internal value chain of each vertical industry. It is a new economic form, which makes full use of the Internet to integrate and optimize production resources, deeply integrates the Internet and traditional industries, and ultimately improves the productivity of the country. However, we are now in the era of consumer internet, existing many barriers in the transformation of enterprises to industry internet. Consumer internet regards consumers as the main body [1], and improves the consumption experience of individual users through e-commerce platform, while industry internet takes producers as the main body, with the purpose of connecting upstream and downstream industries, connecting intelligent devices of enterprise, and empowering different enterprises through industrial internet platform [2]. Since their service objects are different, enterprises need to constantly consolidate and accumulate their own industry insight,

J. E. Ferreira et al. (Eds.): SERVICES 2020, LNCS 12411, pp. 93–100, 2020.
https://doi.org/10.1007/978-3-030-59595-1_8

resource integration, platform empowerment, technology realization and operation management as well as other core capabilities to successfully realize the industry internet transformation [3]. This fundamental difference also leads to the fact that the industry internet not only cares about the links between people, but also needs to combine the technology of internet of things (IoT) [4] to realize the fine business process in industries.

5G related software provides the possibility to meet these needs. It includes the 5th generation mobile networks, internet of things, big data, artificial intelligence and other cutting-edge technologies. It provides the necessary conditions for enterprises to solve the fundamental technical problems faced by upgrading to the industrial internet, and is the basic guarantee for enterprises to obtain the core capabilities mentioned above. Therefore, analyzing and summarizing the influence of 5G related software technology on the development of industrial internet can help enterprises to maintain good growth in the current economic form. The rest of the article is summarized as follows. Section 2 gives an overview of digital economy ecosystem. In Sect. 3, this paper introduces 5G-based industry internet. Finally, Sect. 4 concludes the article.

2 An Overview of Digital Economy Ecosystem

The core of industry internet is industry, and the development of industry and economy is always inseparable. The integration of digital technology and traditional industry has changed the production way in enterprises and commodity trading mode in society, bringing people into the era of digital economy [5]. It refers to an economy that is based on digital computing technologies, and it is also called the internet Economy, the New Economy or Web Economy [6]. Web technology brings us to the era of digital economy 1.0, mobile internet brings digital economy 2.0, and industry internet brings digital economy 3.0 (see Table 1).

Table 1. Three stages in digital economy.

Digital economy	Infrastructure	Main features
1.0	Web	E-business, E-commerce
2.0	Cloud Computing	Business as Services, Mobile E-commerce
3.0	5G related technologies	Data value chain, Industrial value chain

2.1 Digital Economy 1.0

In the context of digital economy 1.0, traditional industries have basically realized digitalization [7]. Three major industries, agriculture, service industry and manufacturing industry, have established basic digital infrastructure [8]. In this era, it is mainly through web technology to change the way of production and commodity trading, to move the traditional offline business to the internet, to promote the sales of commodities through e-commerce platform [9, 10], and to improve the production efficiency through digital

equipment, just as summarized in Table 1. The best example of digital economy 1.0 is to buy clothes and books online.

2.2 Digital Economy 2.0

We are now in the era of digital economy 2.0. Different from the former era, cloud computing is the infrastructure. The changes it brings to the industry development are service-oriented business and mobile e-commerce. Service-oriented business refers to turning customer relationship management, marketing and other general processes into repeatable digital services, and then presenting them in SaaS layer (software as a service). SaaS is the foundation of mobile Internet, and also spawned mobile e-commerce. Now, E-commerce based on mobile internet has become the most prominent feature of digital economy 2.0 (see Table 1).

Mobile internet generates big data [11]. After data aggregation, we can capitalize it and use this data asset to create new value again, which is what technology of big data does. In the future, we will use the data generated by one industry to other different industries, such as applying the data of intelligent manufacturing industry to the financial industry, which is the innovation of business scenario, the era of digital economy 3.0.

3 Digital Economy 3.0

3.1 Basic Concept

The most significant feature of digital economy 3.0 is data value chain and industrial value chain formed on 5G related technologies (see Table 1). In those chains, upstream and downstream enterprises of the industry are linked together, data flows efficiently across industries, and that is the vision of the industry internet.

5G related technologies include some cutting-edge technologies. 5G is the basis of internet of everything [12], internet of things generate big data [13], big data is analyzed by artificial intelligence to expand new business scenarios for enterprises [14], and block-chain secure those scenarios [15]. Innovative intelligent products are the product of the comprehensive application of these new technologies, and also the product of cross enterprise cooperation. In this ecosystem generated by the Innovation scenario, people and things, things and things are all interrelated, data is given new value in the flow, and the market value of related enterprises will increase. So, what problems need to be solved to meet the new economic era?

3.2 Obstacles to the Development of Industry Internet

As mentioned in the introduction Section, the formation of industry internet makes the digital economy upgrade. So the key problems lay in industry internet, such as how to improve equipment connection ability, break the limitations of industrial thinking, and integrate enterprise resources in a wide range.

- Equipment connection ability. In the IoT environment, the number of intelligent devices that need to be connected to the network is increasing rapidly. How to improve the connection ability of the device and the high concurrent access ability of the system is an urgent problem. 5G technology gives us an optimistic future.
- Barriers to industrial thinking. The industrial thinking of large-scale production has shown its disadvantages, that is, it is not conducive to the personalized production requirements and the digital transformation of enterprises. Industrial Internet thinking is the inevitable trend.
- Difficulties in integrating resources across enterprises. In order to make multiple enterprises work together efficiently, all kinds of resources in the product cycle must be integrated together to optimize the product design, production, logistics, marketing and other related aspects by using the industrial Internet platform.

3.3 Solutions for Developing Industry Internet

5G is the key technology to break down the barriers to the development of industry internet, which solves the problems of interconnection of everything and efficient flow of data (see Fig. 1). Device connecting service, radio transmission service, data storage and processing service constitute 5G-based service flow, the key ingredient of which is data flow. It promotes cooperation among enterprises, combination of upstream-downstream resources, efficient production and trading.

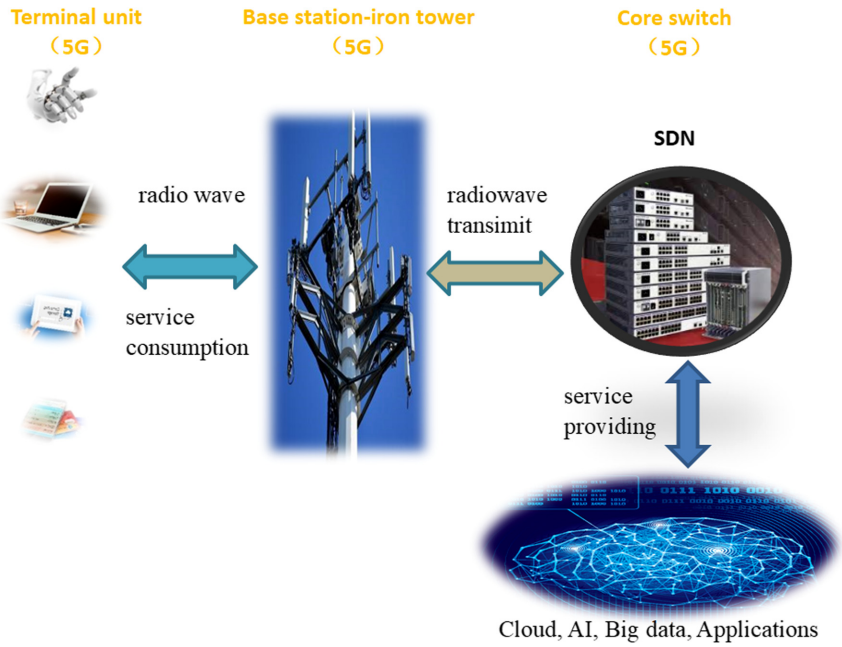

Fig. 1. 5G-based service flow

How can 5G improve equipment connection ability? It is a universal connector that can connect various terminals and services. Number of connected devices in the same area can be improved 100 times than 4G, and data transmission speed is 100 times faster than 4G (20 GB/s). In this way, various intelligent devices and business systems can be connected with each other through 5G message platform. 5G is like contact lenses. Its time delay in communication is only about 0.1 ms, which shortens the distance between users and service providers. 5G can reconstruct the value chain. With the support of 5G technology, the cooperation between enterprises is closer, the space of business innovation is larger, and the new value chain is easier to produce.

How to break the barriers of industrial thinking? The core of industry internet is to empower enterprises through digital transformation and provide solutions cross industry guided by services. Therefore, the solution of industry internet is designed around the service life cycle (see Fig. 2). The life cycle consists of six components: services consulting, services design, services development, services delivery, services operations and services management. By designing solutions around this life cycle, different departments or organizations are linked together. Data will flow when services are conducted between the two components, thus forming a data value chain.

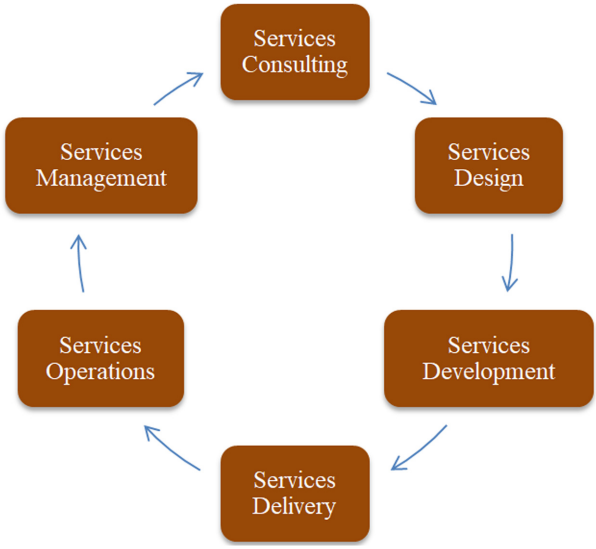

Fig. 2. Service life cycle

In the era of digital economy 3.0, data is an asset. It flows between different phases of service life cycle and will be given new value (see Fig. 3). UGC is short for used, generated and conducted. In the process of business interactions, data are used, generated and conducted. Value of data will continue to increase when data flow through different organizations. The recreated data will finally flow back to the whole data system. This value chain points out the direction of exploring new business model in the new economic

era. Therefore, the essence of the digital economy 3.0 is data value-added services, and the data-driven economy.

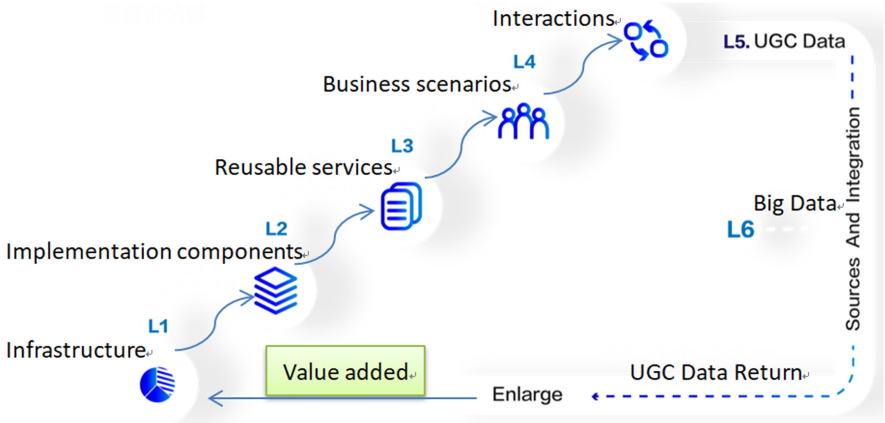

Fig. 3. Data value chain of digital economy 3.0

How to break through the barriers of enterprise resource integration? Industrial Internet is a platform to connect upstream and downstream enterprises and integrate various resources efficiently. Producers, sellers and logistics enterprises can carry out their own business around this platform. The industrial Internet platform will promote the development of enterprises in the direction of digitalization and intelligence.

The industrial internet platform is an open data access platform, which can integrate resources in various fields, promote rapid connectivity between suppliers and demanders, and optimize the resource allocation of enterprises. As shown in Fig. 4, it consists of four parts, edge layer, IaaS, PaaS and SaaS. Edge layer is to connect intelligent devices by using 5G networks, IaaS provides cloud computing function, PaaS integrates software developing tools or intelligent algorithm models and SaaS presents new opportunities for business design and application innovation. The platform can help enterprises collect massive data, store and analyze the data through digital technology. It links the resources of various industries and efficiently schedules the resources among enterprises. For example, in the manufacturing industry, the industrial internet platform can connect the staff, machines, workshops, enterprises and other subjects, and coordinate the design, development, production, sales and other aspects of products [16]. This platform can also be applied to other industry fields, such as oil and gas production, public utilities, large-scale industrial energy management and control center, to intelligentize the whole process of product design, production, commodity marketing, and logistics distribution. The way of internet + industrial manufacturing can enable different enterprises to combine into an industrial internet ecosystem cross industry, and further develop the industry ecosystem. It will form a deep integration of the new generation of information technology and manufacturing industry, and serve for China's intelligent manufacturing.

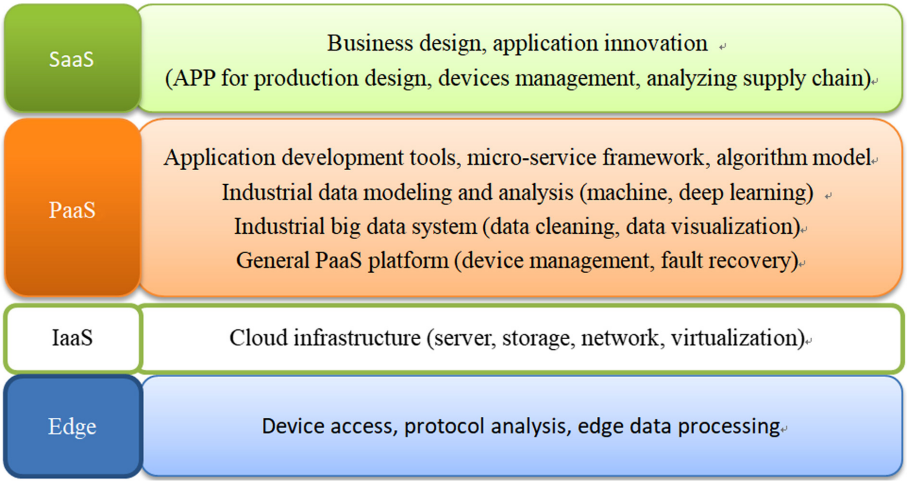

Fig. 4. Solution for industrial internet platform

4 Conclusions

This article introduces the background of industry internet and its relationship with digital economy, analyses the obstacles it encounters in the development process, presents how 5G related technologies contribute to forming industry internet, and puts forward solutions to overcome those obstacles. Conclusion is that, in the new economic situation, if enterprises want to survive and become more powerful, they must actively embrace the industry internet. Leading manufacturing enterprises need to combine 5G related technologies to build industrial internet platform, and use the platform to connect upstream and downstream enterprises. Other relevant enterprises need to actively complete digital transformation and access the industrial internet platform. In that way, all the enterprises associated with one specific business scenario can be linked into a value chain. However, there are still many problems to be solved in exploring innovative scenarios and making use of the industrial internet platform to implement those scenarios, for example, how to combine 5G technology to automatically discover smart devices and services nearby, how to ensure data security when exchanging data between different companies. These aspects are needed to be further studied in the field of industry internet.

References

1. Zhu, F., Li, G.: Study on security of electronic commerce information system. In: International Conference on Artificial Intelligence, Management Science and Electronic Commerce AIMSEC, 8–10 August 2011
2. Zhang, Y., Tao, F., Liu, Y., Zhang, P., Cheng, Y., Zuo, Y.: Long/short-term utility aware optimal selection of manufacturing service composition toward industrial internet platforms. IEEE Trans. Ind. Inform. **15**(6), 3712–3722 (2019). ISSN: 1551-3203

3. De Carolis, A., Macchi, M., Negri, E., Terzi, S.: Guiding manufacturing companies towards digitalization a methodology for supporting manufacturing companies in defining their digitalization roadmap. In: International Conference on Engineering, Technology and Innovation ICE/ITMC, 27–29 June 2017
4. hAnnaidh, B.O., Fitzgerald, P., Berney, H., Lakshmanan, R.: Devices and sensors applicable to 5G system implementations. In: IEEE MTT-S International Microwave Workshop Series on 5G Hardware and System Technologies IMWS-5G, 30–31 August 2018
5. Traub, M., Vögel, H.-J., Sax, E., Streichert, T., Härri, J.: Digitalization in automotive and industrial systems. In: Design, Automation & Test in Europe Conference & Exhibition DATE, 19–23 March 2018
6. Barua, A., Whinston, A.B., Yin, F.: Value and productivity in the Internet economy. Computer **33**(5), 102–105 (2000)
7. Ershova, T.V., Hohlov, Y.E., Shaposhnik, S.B.: Methodology for digital economy development assessment as a tool for managing the digital transformation processes. In: Eleventh International Conference Management of Large-Scale System Development MLSD, 1–3 October 2018
8. Vorobieva, D., Kefeli, I., Kolbanev, M., Shamin, A.: Architecture of digital economy. In: International Congress on Ultra Modern Telecommunications and Control Systems and Workshops ICUMT, 5–9 November 2018
9. Zuo, W., Hua, Q.: The application of web data mining in the electronic commerce. In: International Conference on Intelligent Computation Technology and Automation, 12–14 January 2012
10. Verma, S., Patel, K.: Importance of heuristic algorithms for ontology based search of product in mobile-commerce. In: International Conference on Inventive Systems and Control ICISC, 19–20 January 2018
11. Jiang, W., Wang, Y., Jiang, Y., Chen, J., Xu, Y., Tan, L.: Research on mobile internet mobile agent system dynamic trust model for cloud computing. China Commun. **16**(7), 174–194 (2019)
12. Liu, M., Mao, Y., Leng, S., Mao, S.: Full-duplex aided user virtualization for mobile edge computing in 5G networks. IEEE Access **6**, 2996–3007 (2017). ISSN: 2169-3536
13. Chettri, L., Bera, R.: A comprehensive survey on Internet of Things (IoT) toward 5G wireless systems. IEEE Internet Things J. **7**(1), 16–32 (2020). ISSN: 2327-4662
14. Akpakwu, G.A., Silva, B.J., Hancke, G.P., Abu-Mahfouz, A.M.: A survey on 5G networks for the Internet of Things: communication technologies and challenges. IEEE Access **6**, 3619–3647 (2017). ISSN: 2169-3536
15. Miller, D.: Blockchain and the Internet of Things in the industrial sector. IT Profess. **20**(3), 15–18 (2018). ISSN: 1520-9202
16. Li, Z., Zhou, X., Qin, Y.: A survey of mobile edge computing in the industrial internet. In: International Conference on Information, Communication and Networks ICICN, 24–26 April 2019