

# Research on Development of Cloud Computing Based on Patent Analysis

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**Abstract**—The application patents of cloud computing as data sources are studied in the paper. We mainly use statistical analysis method and social network analysis method and high-level patent analysis was carried out in many aspects, such as main national distribution, main institutions, focal research points and key patents of cloud computing. The research status and competition situation of cloud computing are comprehensively revealed, aiming at providing reference for researchers who are in related fields to understand the development trend of cloud computing.

**Keywords**—patent analysis, cloud computing, patent map

## I. INTRODUCTION

Cloud computing is not a new concept. It is the development of parallel computing, distributed computing, and grid computing, or is the result of the mixed evolution of concepts such as virtualization, utility computing, and software as service. [1] In the cloud environment, a powerful and scalable data and service center is built through virtualization technology to provide enough computing power and large enough storage space for users. At any time and at any place, users can access the cloud and achieve on-demand use as long as they have a terminal that can access the Internet, such as mobile phones. [2]

Google's "Google101 plan" pioneered the cloud system for the first time and made three key technologies in cloud technology: GFS, Map/Reduce and Big Table in 2006. Microsoft's Windows Azure operating system, launched in 2008, implements the server's cloud operating system. Information processing will no longer be desktop centric, but will be allocated by large data processing centers to transfer PC users to "cloud". IBM launched the "blue cloud" plan to distinguish public cloud from private cloud and attach importance to information security. The overall research on cloud computing in China began in 2008. The first cloud computing center was established in Wuxi. After that, the research institutes of science and technology have carried out the research on cloud computing services. [3]

This paper makes a statistical analysis of the patent documents related to cloud computing, discussing the trend of the development of cloud computing technology from multiple angles (time, organization, country, IPC, technology),

and provides some reference value for the technical personnel in the related fields.

## II. DATA SOURCE AND ANALYSIS METHOD

The data used in this paper is the Patsnap patent database, using title/abstract/claims search strategy, and the search time is June 13, 2018. A total of 14682 related patent data were retrieved based on these data, we use Patsnap, Microsoft Excel and other analysis tools to analyze and excavate the data from multiple angles. Since patents are usually delayed for 18 months from application to public, and patent data is often delayed database for about 18 months, the data for 2017 and 2018 is only for reference.[4,5]

## III. PATENT APPLICATION TREND OF CLOUD COMPUTING

From the trend of patent application, we can see that the related research and development of cloud computing started in 2006. The cloud computing showed a steady growth trend in 2008; after 2010, the speed of the research and development of cloud computing was obviously accelerated. The amount of application in the 2011-2014 is more than 2000 items. (Since the patent has a certain time lag from application to disclosure, the figures for 2017 and 2018 are for reference only) (Fig. 1)

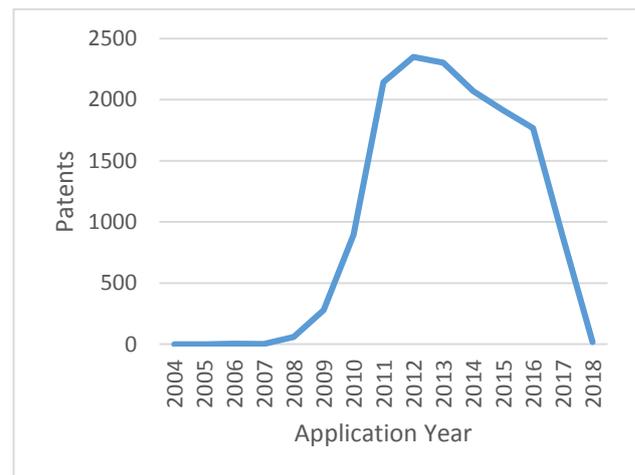


Fig. 1. The global patent application trend of cloud computing

**IV. COUNTRY PATENT APPLICATION TREND OF CLOUD COMPUTING**

From the distribution of patent technology countries, The United States and China have the most patent applications, 10883 items, accounting for 74% of all patents, followed by Korea and Germany, and their patent application accounts for 7% of the total, and patents of other countries are within 300 items.(Fig. 2)

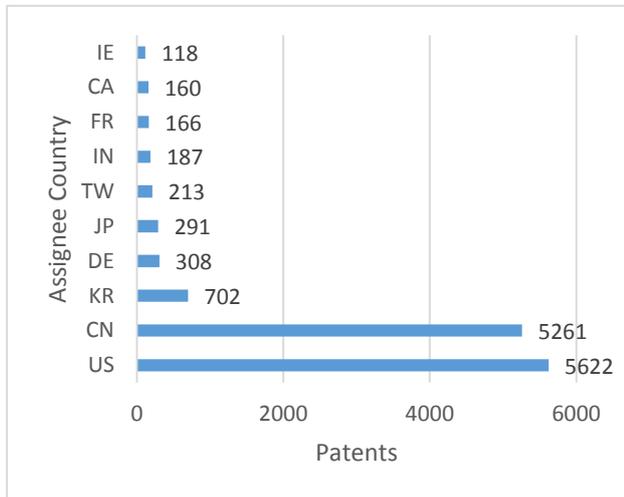


Fig.2. Country patent application trend of cloud computing

**V. ORGANIZATION ANALYSIS**

**A. Top 9 Organizations Patent Application Trend of Cloud computing**

Top 10 applicants are IBM, MICROSOFT, LI ZONGCHENG, INSPUR, HUAWEI, ERICSSON, VMWARE, INTEL, ORACLE INT and GOOGLE. Six organizations are in the United States accounting for 16% of the total number of patent applications. ERICSSON is a mobile communications equipment manufacturer in Sweden. INSPUR is one of the leading cloud computing and cloud recognition leaders in China. HUAWEI is the world's leading ICT (information and communications) infrastructure and intelligent terminal provider, headquartered in China. Li ZONGCHENG is a personal patent applicant in China.

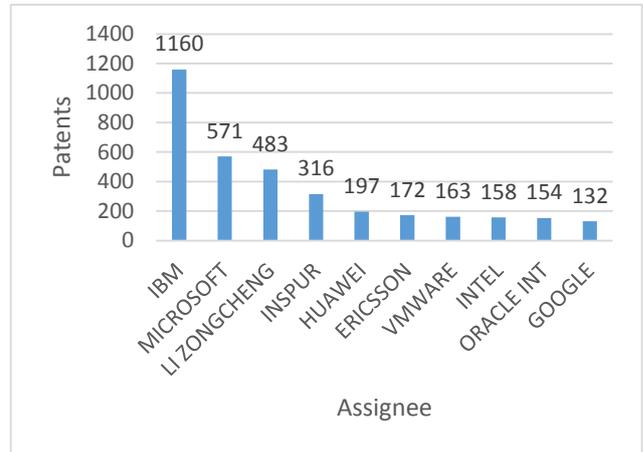


Fig.3. Top10 assignee of cloud computing

From Fig. 4, it can be seen in the last 10 years that TOP 9 organizations have applied for a certain number of patents each year. In the year of 2011-2016, the number of patents in grew rapidly. The 2013-2016 was the highest peak of development and the most patent applications were applied in the four years. In 2015, IBM applied for 204 items, which exceeded many other companies.

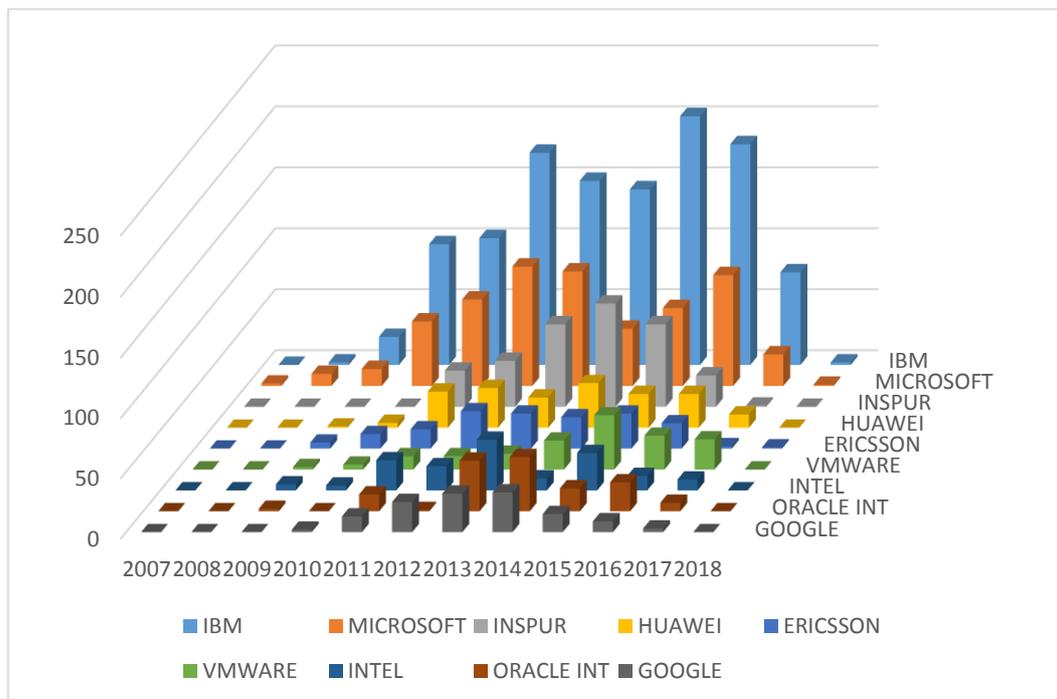


Fig.4. Top 9 organizations patent application trend of cloud computing

**B. Analysis of Technology Market of Top 9 Organizations**

IBM has a layout in the United States, China, the Great Britain and Germany, and MICROSOFT is wider, such as the United States, China, EPO, Korea, Canada, Hong Kong and

India. INSPUR has a layout in China only. ORACLE INT, ERICSSON and HUAWEI all have a layout in the United States, China, EPO and India. (Fig. 5)

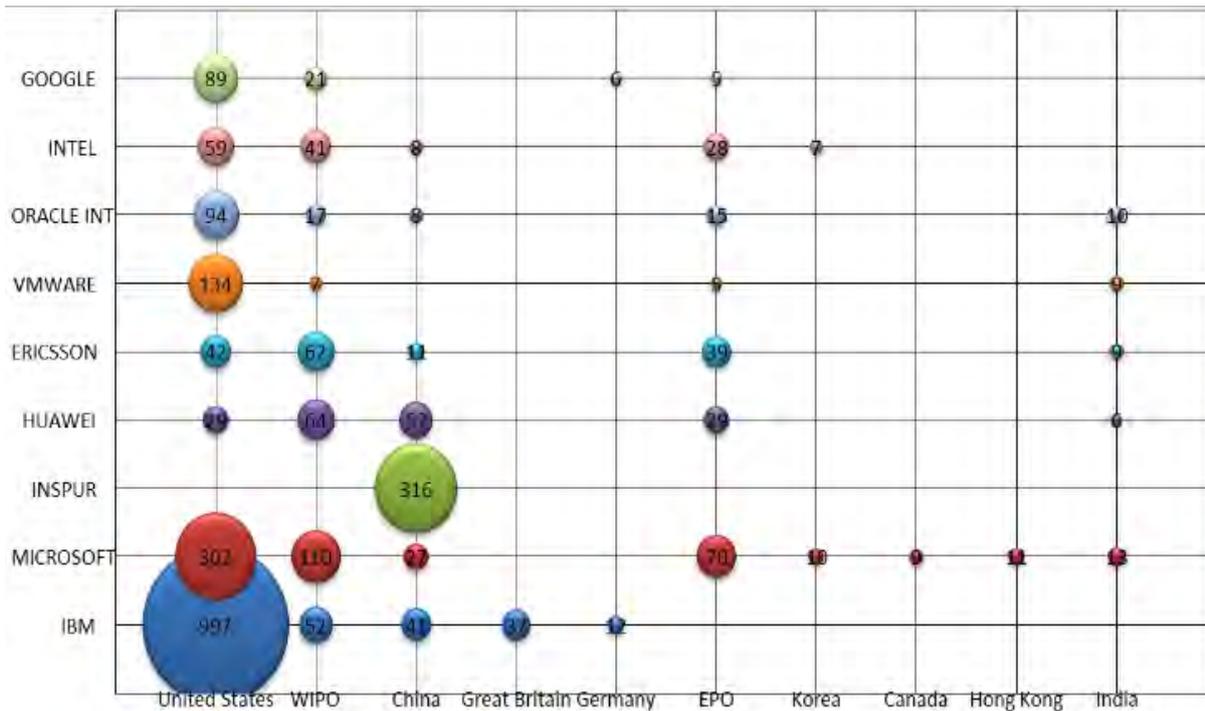


Fig.5. Technology market of Top 9 organizations

## VI. DISTRIBUTION OF TECHNICAL THEME

### A. Statistics from IPC

Cloud computing technology refers to the integration of hardware, software, network and other series of resources in the WAN or LAN to realize the computing, storage, processing and sharing of data. The main classification numbers in the patent literature are H04L(TRANSMISSION OF DIGITAL INFORMATION) and G06F(ELECTRIC DIGITAL DATA PROCESSING), and the classification number of cloud computing technology is mainly: H04L29/08 (Transmission control procedure), H04L29/06 (characterised by a protocol), G06F17/30 (Information retrieval; Database structures therefor), G06F9/50(Allocation of resources), G06F15/16 (Combinations of two or more digital computers each having at least an arithmetic unit, a programme unit and a register).

As can be seen from Fig. 6, the proportion of major technology patents is as follows: H04L29/08 (29.8%, 4370 items), H04L29/06 (1260%, 1843 items), G06F17/30 (8.8%, 1296 items), G06F9/50(8.4%, 1226 items), G06F15/16 (7.3%, 1071 items), H04L12/24 (6.7%, 978 items), G06F9/455 (6.6%, 965 items), G06Q10/00 (4.3%, 630 items), G06F9/44 (3.6%, 532 items), G06F15/173 (3.5%, 514 items).

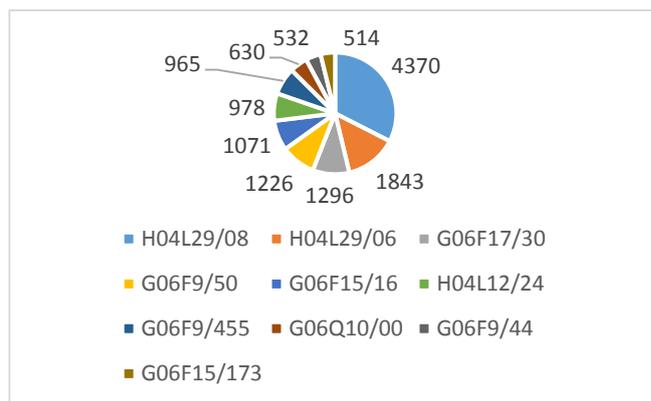


Fig.6. The statistics of TOP 10 IPC groups

### B. Key Technology Analysis — Patent Map of Cloud computing

Analyzing 5203 items, which authority is China, we can see the main technical topics of cloud computing patents include: (1) Internet, thing, big data, network, server; (2) thing, internet, intelligent, cluster, server; (3)network, internet, thing, scheduling, virtual machine; (4) Internet, thing, big data, intelligent, scheduling; (5)virtual machine, network, big data, providing, information; (6)server, big data, virtual machine, searching, analysis;(7)scheduling, virtual machine, resource, software, operating;(8)virtual machine, scheduling, terminal, facing, realizing;(9)design, internet, configuration, technical support, communication technology . (Fig. 7 )

Analyzing 5139 items, which authority is US, we can see the main technical topics of cloud computing patents include: (1) cloud service, network, computing, resource, hybrid cloud,

exposure; (2) resource, mobile, networked computing, communication control; (3) control, information, sound, recording, virtual; (4) control, information, controlled, smartphone, web-based cloud; (5) hosting, migrating, architecture, automated, shared; (6) program, application,

storage, generating, resource; (7)integrated, platform, apparatus, bioinformatics system, circuit; (8) infrastructure, networked computing, security, virtual computing, securing, etc.(Fig.8 )



Fig.7. The patent map of cloud computing (Authority: China)



Fig.8. The patent map of cloud computing (Authority: US)

## VII. SUMMARY

According to the patent literature, the research status and development trend of cloud computing technology are revealed by data mining and information analysis from the

global patent application trend, technology source country, technology application country, hot spots of the patent holder. We can find the strength of international cloud computing research, and the distribution of relevant research hotspots.

(1) After 2011, the number of patent applications of cloud computing technology began to increase, and the growth rate was obvious during the 2013-2016 period. This period was also the stage of rapid development of cloud computing technology.

(2) The patent application organizations of cloud computing technology are mainly concentrated in the United States and China, and the layout of these organizations is distributed in the United States, China, EPO, Korea and India and so on.

(3) There are six American companies in the top 10 applicants accounting for 16% of the total number of patent applications.

(4) The patents of the United States covers a wider theme superior to China in the focus of cloud computing technology.

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