

# PATENTING TRENDS IN SECURE DECENTRALIZED COMMUNICATION

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## ABSTRACT

Patenting is one of the important parts of any scientific research in cases when researches pretend to be commercialized. One of the interesting areas in computer science is secure decentralized communication, and this article reviews patenting trends in this area. Therefore, there are two main objectives in the article: first, to determine patent trends in communication security, and secondly, to determine patent trends in decentralized communications. After all, we should make conclusions about patenting prospects in the reviewed area.

**Keywords:** *Patenting Trends, Secure Communications, Decentralized Communications, Patenting Analyzing*

## 1. INTRODUCTION

In recent years, the issues of providing security of Internet communications have received much attention from both the IT community, and from the regulatory authorities. In particular, of the National Institute of Standards and Technology of the USA [1] published recommendations on the safety in 2005, which consider the security problems of the means of voice transmission over the Internet and signaling protocols such as SIP and H.323.

Such an interest in VoIP security is a consequence of the fact that VoIP hacking can be rather easily monetized [2]. For example, having found an error in a service, an attacker can make calls to paid services, "sell the line" or send audiospam. At different times, vulnerabilities have been discovered in solutions like Cisco, Skype, Asterisk and some others [3].

It should also be noted that currently there is a continuous growth of cloud computing market, which inevitably leads to the transfer of the communications to the cloud. In this case the main tool of the user becomes the web browser, which has only a certain functionality to implement communications, so when designing a system of secure decentralized communications on the Internet, it is necessary to take into account technologies that are used in the web browser.

Interest in this area is reflected in the patent activity of developers. In particular, according to

the annual report of Thomson Reuters «Revolutionary fundamental innovations" in the period from 2009 to 2015 growth of patent documents in the field of information technology was more than 63% [4], which indicates the high growth of the information technology industry in the world. The number of patent applications filed in the VOIP security for the same period grew even faster - by 2.6 times (according to the results of our patent search).

It should be noted that the patent research is one of the most effective tools for analysis of technology trends, and competitive environment [5, 6]. Among the indisputable advantages of patent information, we should point out its completeness, timeliness and reliability. According to WIPO [7] significant part of the technical information presented in patents is never published before and the total amount of patent documents worldwide includes approximately 40 million items.

Patent information can be used for a wide range of tasks at different levels of governance (corporate and public administration), including an analysis of technology trends, competitor analysis, and others. [8]. In particular, the patent information can be used to analyze the trends in the global technology adoption, for example, this task can be done by analyzing the patent citation geography [9]. The analysis of patents statistics can be used to evaluate the intentions of companies in terms of the penetration of foreign markets. The technical information contained in patent documents, reveals

the technological basis of competitive advantages of its main company competitors. In addition, this information allows company to select potential partners for joint research and/or cross-licensing [10].

This article presents the results of research and analysis of patent documents for the purpose of identifying and analyzing technological trends in the field of secure decentralized communication. This research based on the study of the patenting dynamics, patenting geography, and the analysis of the competitive environment. Reviews of scientific and other non-patent documents are given in our papers [11,12]. The chosen object of study includes the following components:

- systems and communication methods in a decentralized network;
- systems and methods providing communication security in a decentralized network.

The following parameters were used for the analysis of technological trends:

- Patent age (patenting dynamics). This indicator reflects the technological activity in the study area in retrospective and at the date of the survey. In this article, the patenting dynamics is visually represented as a time diagrams of patent activity.
- Competitive environment. The indicator reflects the level of competition or monopolization of the investigated market segment with the help of the patent tools. Visually the indicator is presented in the form of patent distribution chart in the selected area by applicants.
- Citation Index (direct quotation) reflects the number of citations of a patent in the further patent publications, and it is a measure of the impact that has had a patent under consideration on the following developments in the study area.
- Reverse citation refers to the number of patents, cited by a patent under consideration. This figure, together with the indication of process cycle period may indirectly serve as a measure of technological progress, that is, it shows the degree of elaboration of the technology.
- Status of security documents is a measure of the implementation level of patented solutions, as well as the duration of the technological cycle.

These indicators are calculated using the automated system Patent Lens [13].

The above discussed indicators are systematized by the following groups:

- dynamics, patenting geography and competitive environment;
- technological attractiveness;
- patent families;
- status of security documents.

## 2. ANALYSIS OF PATENT SITUATION IN THE FIELD OF COMMUNICATION SYSTEMS AND METHODS IN A DECENTRALIZED NETWORK

### 2.1 Dynamics, Patenting Geography And Competitive Environment

Figure 1 shows the distribution of submitted applications and obtained patents related to systems and methods of communication in a decentralized network by countries. As the figure shows, the majority of found developments are patented in the USA and internationally. Japan and Germany are also among the leading markets in the industry.

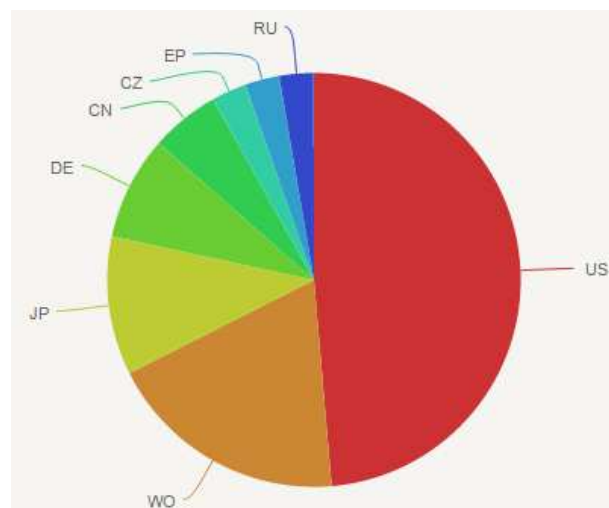


Figure 1 – Patenting Geography In The Field Of Systems And Methods Of Communication In A Decentralized Network (Figure Was Made In System Patent Lens[13])

The peak of patent activity falls on 2015; currently in the field of systems and methods of communication in a decentralized network, the dynamics of patenting is at the level of 4 applications per year (figure 2). The number of patent applications is increasing, which may be an

indication that the process of technology development in this field is in the growth stage, and the technology itself remains attractive in terms of research and development.

In terms of statistics the number of applications is relatively small, but Figure 2 illustrates the stability of the growing trend.

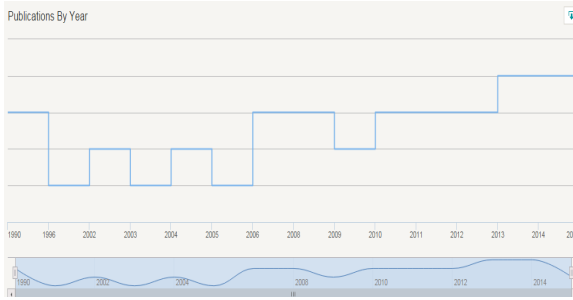


Figure 2 – The dynamics of patenting in the field of systems and methods of communication in a decentralized network (figure was made in system Patent Lens[13]).

The patents in this field are distributed relatively uniformly between the patent owners. The largest number of patents is owned by Macrovision Corp (now Rovi corp), Figure 3.

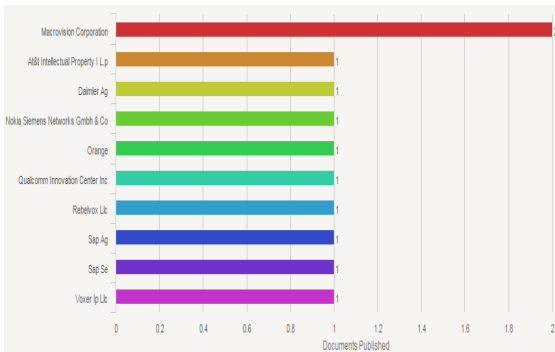


Figure 3 – Patent owners in the field of systems and methods of communication in a decentralized network (figure was made in system Patent Lens[13]).

## 2.2 Analysis Of The Technical Level

Analysis of patent documents related to systems and methods of communication in a decentralized network has revealed the following tasks of inventions:

- Increasing the efficiency of data transmission;
- Increasing the sustainability of data transmission;

- Increasing reliability and security of network and network facilities;
- Increasing network efficiency.

Valuation of attractiveness of technical decisions concerning systems and methods of communication in a decentralized network is based on a review of citations of patent documents. Table 1 shows the number of patent documents with the highest number of citations in other patent applications, which means that these patents have the greatest technological attractiveness.

Table 1 – Documents most cited in other documents

Application/patent number	Number of citations in other patent documents
US6671737	43
US2005/0089014	28
US8316443	13
US7024686	6
US2009/0172824	4

The greatest number of citations has been found for patent US6671737 Decentralized network system. The application for the invention filed in 1999. The number of citations of 10-15 years old patent documents indicates that the basic development started in the early 2000s continues to serve as a basis for further ongoing improvements.

## 2.3 Analysis Of Legal Protection Status Of Documents

The distribution of documents selected for the analysis by the legal status is shown in Figure 4.

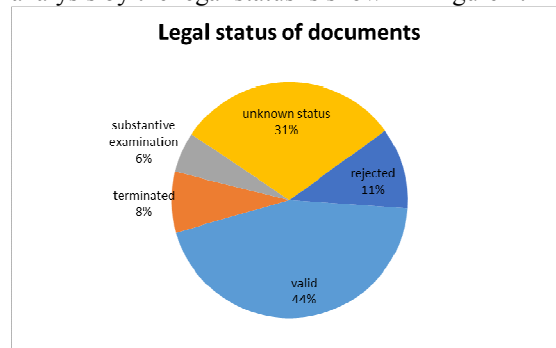


Figure 4 – Status of patent documents on 10.11.2015

Figure 4 shows that in the examination stage is only 6% of selected documents and almost half of presented documents are valid patents, which also indicates that, despite the increase in patent activity, the major solutions in the analyzed area developed over a long period since the end of the 90s. A small

number of terminated patents (8%) indicates that the patent holders proceeds with patent application continuation and use them in competition with other companies.

#### 2.4 Analysis Of Relations Of Found Documents With Other Patents

"Patent Family" is a very important concept both for the legal protection of inventions, and for determining the strategic markets of firms. If, when applying for a patent or obtaining it, the firm specifies the country in which it will apply for the invention, it is a clear signal that a particular company has serious plans for business development in these countries; that is, it is a priority to enter into the market of this country (countries).

Table 2 - Documents having the largest patent families

Applica tion/pat ent number	Name	Patentin g country	Numb er of patent familie s
US2014 030450 1	Method and system for establishing a trusted and decentralized peer-to-peer network	USA, Australia, Japan, Portugal, Spain, Denmark	18
US8806 555	Decentralized media delivery network	USA, Australia	8
US2008 031692 9	Method and Network Element for Guaranteeing a Quality of Service in a Decentralized Network	Korea, China, USA, Germany	6
US8316 443	Method and system for protecting a message from an XML attack when being exchanged in a distributed and decentralized network system	Germany, Austria, USA	6
US2011 011041	Multicellular cooperative	USA, France	5

Applica tion/pat ent number	Name	Patentin g country	Numb er of patent familie s
4	communications in a decentralized network		

These data shows that the most attractive for developers are the markets of the USA, Australia, Germany, France, China and Japan.

### 3. ANALYSIS OF THE PATENT SITUATION IN THE FIELD OF SYSTEMS AND METHODS OF PROVIDING SECURITY OF COMMUNICATIONS IN A DECENTRALIZED NETWORK

#### 3.1 Dynamics, Patenting Geography And Competitive Environment

Figure 5 shows the distribution of submitted applications and obtained patents related to systems and methods of providing communications security in a decentralized network on a global scale. As the figure shows, the majority of found developments are patented in the USA and Korea.

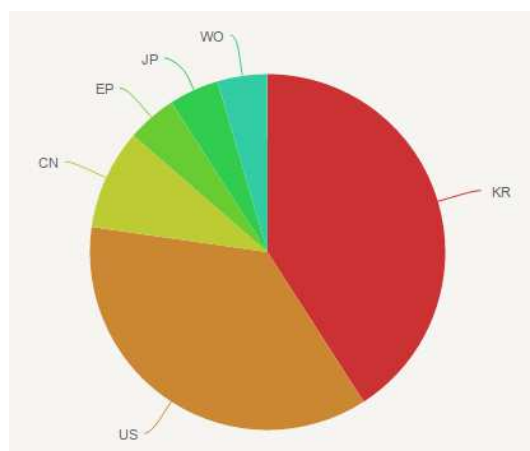


Figure 5 – Patenting geography of systems and methods of providing communication security in a decentralized network (figure was made in system Patent Lens[13])

The peak of patent activity falls on 2015; currently in the field of systems and methods of providing communication security in a

decentralized network, the patenting dynamics is at the level of 3 applications per year (figure 6).

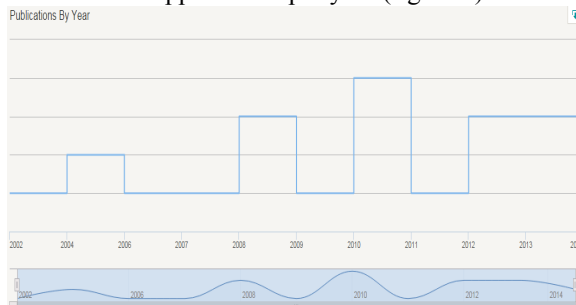


Figure 6 – Patenting dynamics of systems and methods of providing communication security in a decentralized network (figure was made in system Patent Lens[13])

The trend in Figure 6 was compared to historical data on patenting in the field of the decentralized security of VoIP networks (which is presented in Figure 7). Comparison showed that patenting in the field of the decentralized security of VoIP networks is more active.

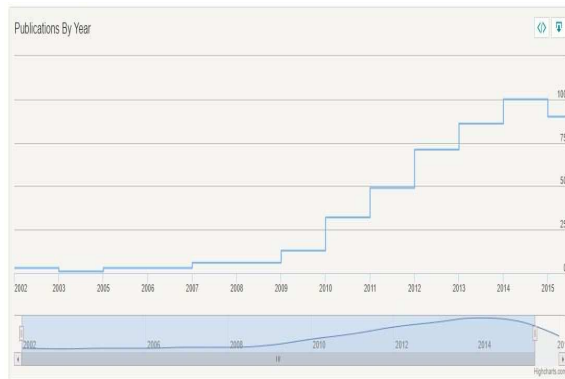


Figure 7 – Patenting dynamics in the field of the decentralized security of VoIP networks (figure was made in system Patent Lens[13])

Note that both areas passed the peak of patent activity. This pattern is typical for technologies which development stage corresponds to the saturation of the logistic curve. We emphasize, however, that in order to confirm this hypothesis, it is necessary to collect statistics for another 1-2 years, which will highlight the trend more clearly.

The patents in this field are distributed relatively uniformly between the patent owners, Figure 8. The largest number of patents owned by following Korean companies: Korea Information Security Agency, Samsung and Hannam University. This confirms the development of the study area in the Asian market.

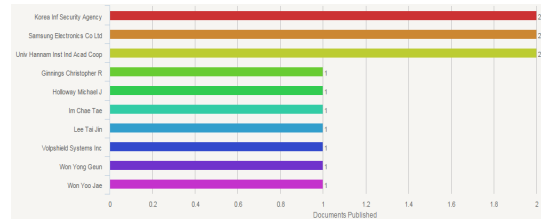


Figure 8 – Right holders in the field of systems and methods of providing communication security in a decentralized network

### 3.2 Analysis Of The Technical Level

Analysis of patent documents related to systems and methods of providing communication security in a decentralized network has revealed the following tasks of inventions:

- Increasing security level;
- Improving the communication quality;
- Reduction of system overload level.

Valuation of attractiveness of technical decisions concerning systems and methods of providing communication security in a decentralized network is based on a review of citations of patent documents. In this case, it refers to the analysis of "direct quotation", which allows identifying the number of citations of a patent protecting the technology, the attractiveness of which we define, as well as competitors.

Table 3 shows the number of patent documents with the highest number of citations in other patent applications, which means that these patents have the greatest technological attractiveness. The largest number of citations was found for invention on application US2004086093, VoIP security monitoring & alarm system. Patent application was filed in 2004.

Table 3 – Documents cited in other documents

Application/patent number	Number of citations in other patent documents
US2004086093	210
US2002129236	105
US2007177615	20
US2010064362	13
US2008240128	12
KR100838811	5

The number of citations of 10-15 years old patent documents indicates that the basic development started in the early 2000s continues to serve as a basis for further ongoing improvements.

### 3.3 Analysis Of Legal Protection Status Of Documents

The distribution of documents selected for the analysis by the legal status is shown in Figure 9.

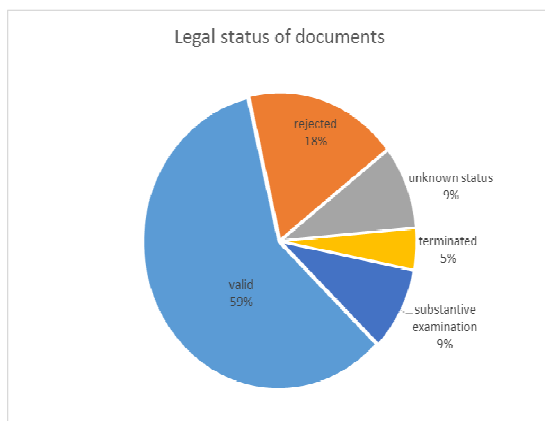


Figure 9 – Patent documents status on 10.11.2015

### 3.4 Analysis Of Patent Families

From a sample of patents related to the field of systems and methods of communication in a decentralized network, the documents in Table 4 have the greatest number of families.

Таблица 4 - Documents having the largest patent families

Application /patent number	Name	Patenting country	Number of patent families
US20020129236	VoIP terminal security module, SIP stack with security manager, system and security methods	USA, Finland	6
EP1916817	Call diversion for a VoIP telephone connection where a redirection server is implemented in a security module	Germany, Austria	4
WO2004092877	VOIP security intelligence systems and methods	USA	4

These data shows that the most attractive for developers are the markets of the USA, Germany, Austria and Finland.

### 4. CONCLUSION

Patent researches in the field of secure decentralized communication have identified more than 60 relevant patent documents. Generalization of the results of patent research shows that developments in the field of secure decentralized communication have been being patented actively since 2000, and the patent activity peaks are noticed in recent years (2010-2015).

The analysis of the technical level showed that the following tasks of inventions are typical for the studied technical field:

- Increasing the efficiency of data transmission;
- Increasing the sustainability of data transmission;
- Increasing reliability and security of network and network facilities;
- Increasing network efficiency;
- Increasing security level;
- Improving the communication quality;
- Reduction of system overload level.

Patents in the field of secure decentralized communications are distributed relatively uniformly between the patent holders. Most applicants have one or two applications for inventions in the subject area.

Peak of the patent activity in the field of communications systems and software security methods in a decentralized environment was in 2010-2011. It will lead us to hypothesis that this pattern is typical for technologies which development stage corresponds to the saturation of the logistic curve. Additional confirmation for this hypothesis is received from the fact that only 9% of reviewed patents are in expertise stage, and over 50% are active patents. Developers in these fields of information technologies can use these results as marker that there is not much space for additional research in these fields (as all-major solutions already patented from 2000 until now).

Analysis of patent families revealed that for developers in the field of communications in a decentralized environment the most promising and has highest priorities are the markets of the USA, Germany, France, Korea and Japan.



## 5. ACKNOWLEDGEMENTS

The article is published under financial support of the Ministry of Education and Science of the Russian Federation. The unique identifier of the applied scientific research RFMEFI57614X00086.

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