

IEEE/ACM Transactions on Networking: A Bibliometric Study

*Bidyut Kumar Patra**

Librarian, Central Library, Asansol Engineering College, Asansol, West Bengal, India

Abstract

This study analyzes the bibliometric characteristics of the journal "IEEE/ACM Transactions on Networking" published by IEEE Networking Society during 2012–2016. Data were collected from the online archives. The study focuses on year wise publication pattern of articles, reference pattern, authorship pattern, degree of collaboration, citation analysis, geographical distribution of papers etc. The study reveals that most of the papers are multiauthored and authors from United States contributed the most.

Keywords: *Bibliometrics, authorship pattern, degree of collaboration, citation analysis, reference*

***Author for Correspondence** E-mail: bidyut.aec@gmail.com

INTRODUCTION

Bibliometrics

Much before the use of the term 'bibliometrics', Hulme in 1923 had used the term 'statistical bibliography' to throw light on the development of a discipline by means of counting and analyzing its various facets of written communication. Raising had defined 'statistical bibliography' as the assembling and interpretation of statistics relating to books and periodicals. S.R. Ranganathan had used the term 'librametry' to include statistical approaches to study library and its services. The term 'bibliometrics' was first used by Pritchard (1969). 'Biblio' means book and 'metric' means a scale or measure. Bibliometric means application of statistical methods in library and information science. According to him, 'bibliometrics is defined as the application of mathematics and statistical methods to books and other media of communication'. Potter, in 1981 had defined the term bibliometrics as the study and measurement of the publication pattern of all forms of written communication and their authors. Recently Sengupta had defined the term as organization, classification and quantitative evaluations along with their authorship by mathematics and statistical calculations.

Thus, bibliometrics is the quantitative analysis

of information sources such as books, periodicals, etc. In bibliometric study, authorship pattern, subject covered, references, citation, geographical distribution of contribution are analysed using quantitative method. Research trend, dominant area of research of any field may be identified by applying bibliometric method. It is an important tool to evaluate research performance of an institution and also helpful for collection development of a library. Bibliometric studies are helpful in evaluating library service, collection development and resource allocation. Volume of scientific and technical literature is increasing day by day. With the limited resource, it is impossible for the library to cope up with the increased volume of scientific literature. Using bibliometric method, core journals of a particular subject may be identified.

IEEE/ACM Transactions on Networking

The Institute of Electrical and Electronics Engineers (IEEE) publishes world's most cited publications on electrical engineering, electronics and communication engineering and computer science. The IEEE/ACM Transactions on Networking is a peer-reviewed bimonthly scientific journal published by IEEE Communication Society, IEEE Computer Society and Association for Computing

Machinery. The journal publishes original and scientific works on communication and computer networks. Major disciplines covered include internet and computer networks, wireless networks, sensor networks, cellular networks, optical networks, radio frequency identification technology and others.

LITERATURE STUDY

Nagsarkar Subhada, Veer Chaitanya and Kumbhar Rajendra in their study found that total 125 papers (18%) are written with international collaboration and highest number of collaboration (41) with USA [1]. Total 51 (41%) of the 125 international collaboration are with European countries. The study also reveals that papers written with international collaboration have received 26% citations.

Mishra Devendra Kumar, Gawde Manisha and Solanki Madhu Singh in their study found that most of the scholars in English prefer books as the most preferred resource. 80.47% citations are taken from books [2]. They also showed that single author is cited most.

Roy Shanku Bilas and Basak Moutusi in their paper "Journal of Documentation: A Bibliometric Study", stated that out of 246 contributions United Kingdom contributed the most (79) followed by USA, Finland, Australia and Denmark [3]. Degree of collaboration is 0.51, i.e., majority of the researchers prefer to publish their paper jointly.

Thanuskodi S. in his study "Bibliometric Analysis of Indian Journal of Agricultural Research" stated that maximum number of contributions is joint authors (93.69%) [4]. Most of the contributions are from India (98.67%) while foreign contribution is very less.

Tsay Ming-Yueh in his study found that average number of citation per paper was 33 [5]. On an average, there were 1484 references cited per year and the number was increasing. Journal articles were the most cited followed by books, and book chapters, conference proceedings, electronic resources.

Velmurugan C. and Radhakrishnan N. in his paper analyzed yearly/monthly distribution of

papers, authorship pattern, geographical distribution of contributions and degree of collaboration [6]. He observed that highest number of contributions were published in the year 2007, highest number 436 (97.33%) were contributed by joint authors and the rest by single author. Most of the contributions are from India.

Panda Ipsita, Maharana Bulu and Chhatar Durlav Charan in their study "Journal of Information Literacy: A Bibliometric Study", revealed that highest number of papers (68.7%) are by single author [7]. The level of collaboration is very low. Average number of citations per paper is 12.

Angamanna A.M.S. and Jayatissa L.A. in their study "A Bibliometric Study of Postgraduate Theses in Library and Information Science with Special Reference to University of Kelaniya and University of Colombo" observed that books and journals are the most used reference materials [8]. 39% citations are books whereas journals are 34%. It was also found that current scholarly materials have not been used by the researchers.

Ambika and others in their study "Bibliometric Study of Annals of Library and Information Studies" showed that number of articles differs from year to year and there is also a steady increase in number of articles [9]. The study also reveals that highest proportion (44.25%) of articles was published by two authors followed by single author contribution (33.92%). When geographical contribution is taken into account, it is found that Indian authors contributed maximum number of articles.

Kumar Shailendra and Naqvi Sheabaz Hussain in the study "Collaboration Pattern in the Field of Natural Sciences at Jamia Millia Islamia, New Delhi During 1971–2007" showed that there are 231 (18.38%) singled author papers, 297 (23.63%) two authored papers and 365 (29.04%) are collaborated by three authors [10]. Number of paper published was 01 in 1971, i.e., 0.08% of the total paper published rose to 136 in 2005 which was 10.82% of the total papers.

Naser Mirza Muhammad and Mahmood

Khalid suggested that LIS research in developed countries should be shared with other LIS professionals through publication and online communication so that the research culture may also flourish in those countries that pay less attention to the research [11]. As the use of bibliometric methods requires wider access to the literature, publisher and online service providers should facilitate research by providing access to the relevant literature.

OBJECTIVE OF THE STUDY

The study has been undertaken to find out the following:

- i. To find out year wise distribution of papers
- ii. To analyse authorship pattern
- iii. To know number of references per paper
- iv. To find out geographical distribution of papers
- v. To know subject covered
- vi. To find out the degree of collaboration

METHODOLOGY

Five volumes (vol. 20–24) containing 29 issues (5 issues in 2016) published during the

period 2012–2016 are considered for the study, data were collected from the online archives of the journal. Details of the published articles such as authorship pattern, references, subject covered, geographical distribution etc. are collected and calculated using different statistical techniques.

DATA ANALYSIS

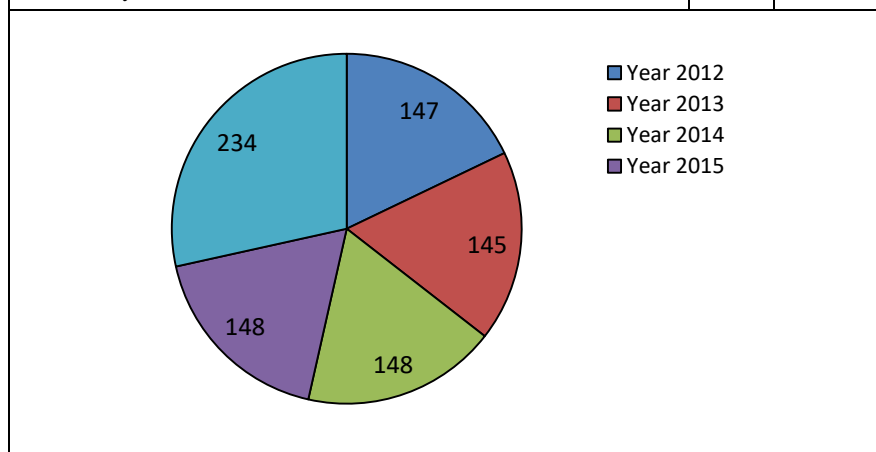
Issue Wise Publication Pattern

Table 1 shows the number of papers published in each issue published during the period 2012–2016. 29 issues were published during the time of study, six issues in vol. 21–25 and five in vol. 26. All total 822 papers were published with an average of 164.4 per year. Maximum 234 papers were published in 2016 in five issues.

It is observed that in an average 24.5 papers per issue were published from the year 2012 to 2015 (from vol. 2–23) but 234 papers were published in the year 2016 with an average of 46.8 per issue which clearly indicates the current growth of research in the field of internet and computer networking.

Table 1: Number of Papers Published in Each Issue Published during the Period 2012–2016.

Year	Issue 1	Issue 2	Issue 3	Issue 4	Issue 5	Issue 6	Total	Average
2012	23	23	25	25	26	25	147	24.5
2013	25	23	24	24	24	25	145	24.1
2014	25	24	25	25	23	26	148	24.6
2015	24	25	24	26	25	24	148	24.6
2016	46	46	46	47	49		234	46.8
Total in 5 years							822	164.4



Authorship Pattern

Table 2 shows the authorship pattern and it is clear that collaborative pattern is the trend of research. Out of 822 articles, only 16 articles are single authored. Rest are multiauthored. 227 articles (27.61%) are three-authored followed by 200 (24.33%) five-authored or more, 190 (23.11%) four-authored and 189 (22.99%) articles are by two authors.

papers. It has been decided on the basis of the address and affiliation of the first author. From the study, it is clear that maximum number of papers (43.7%) is from USA followed by China (11.6%), Italy (3.4%), Canada (3.2%), India (2.7%), France (2.2%), Israel (2.2%), Korea (2.1%) Singapore (2%), Spain (1.8%), Germany (1.5%) and UK (1.3%). Rest 169 articles (20.6%) are from other countries. Indian authors contributed 2.7% though almost all are affiliated to Universities or Research Institutes locating mainly in the U.S.A.

Geographical Distribution of Papers

Table 3 shows the geographical distribution of

Table 2: The Authorship Pattern.

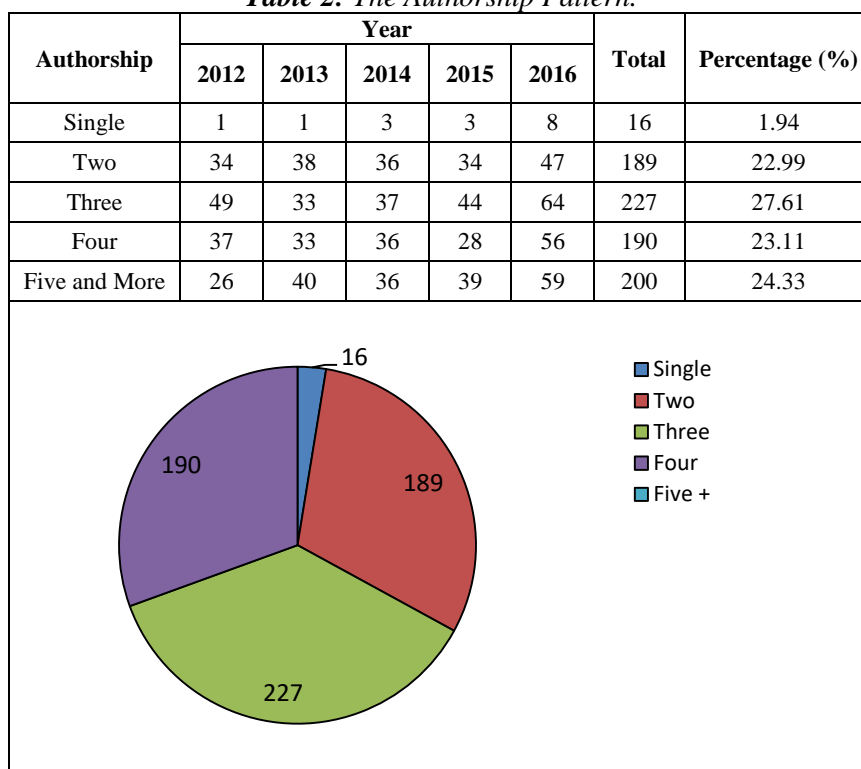
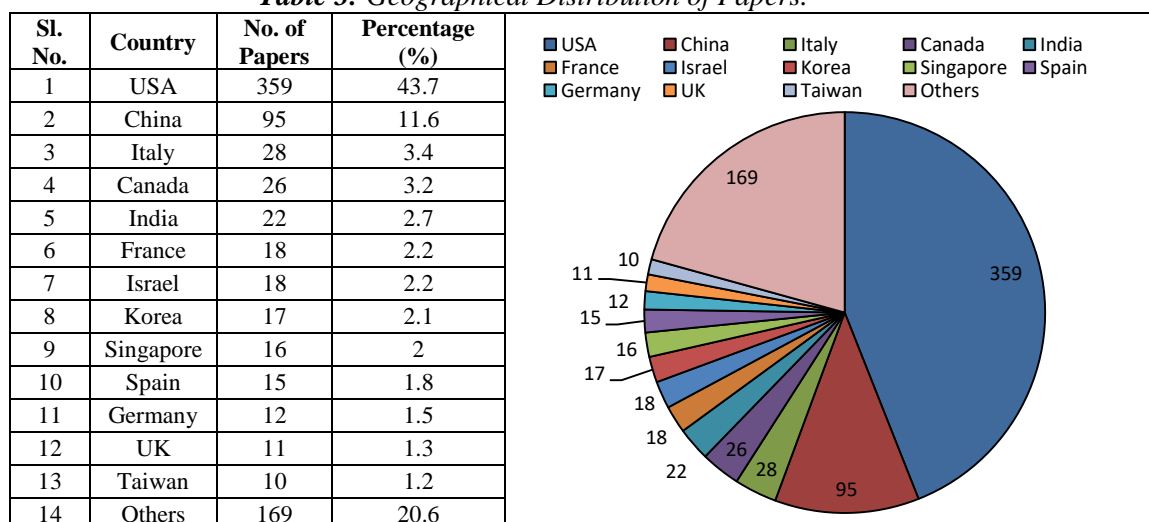


Table 3: Geographical Distribution of Papers.



Number of Papers versus Number of References

Table 4 shows average number of references given in the issues published during the period. All total 27321 references are given in 822 articles published with an average of 33.24 per issue. Maximum 8194 references are given in five issues and 148 articles published in the year 2016 with an average of 35.02 followed by 4856 references (33.03%) in 2012, 4845 references (32.74%) in 2014, 4775 (32.26%) in 2015 and 4651 (32.07%) in 2013. Increased number of references per issue in recent years clearly indicates the growth of scientific literature in the field of networking.

Subject Covered

IEEE/ACM Transactions on Networking publishes papers all fields of networking. Table 5 shows the number of papers published

in different fields during the period of study. Maximum number 401 papers (48.78%) are on internet and computer networking followed by 158 papers (19.22%) on wireless communication, 75 papers (9.1%) on cellular network, 51 (6.2%) on wireless sensor network and others 137 papers (16.7%) on other aspects of communication and networks.

Degree of Collaboration

The extent of collaboration in research can be measured by the formula given by Subramanian (1982).

$$\text{Degree of Collaboration DC} = \frac{Nm}{(Nm + Ns)}$$

Where,

DC = Degree of collaboration,

Nm = No. of multi-authored papers,

Ns = No. of single authored papers,

Here, DC = 806/(16 + 806) = 0.981.

Table 4: Average Number of References given in the Issues Published during the Period.

Year	No. of Articles	No. of References	Average
2012	147	4856	33.03
2013	145	4651	32.07
2014	148	4845	32.74
2015	148	4775	32.26
2016	234	8194	35.02
Total	822	27321	33.24

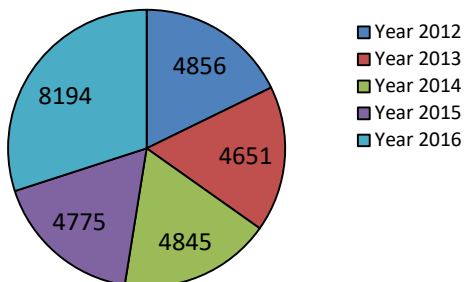


Table 5: Number of Papers Published in Different Fields during the Period of Study.

Sl. No.	Subject	No. of Papers	Percentage (%)
1	Internet and Computer Networking	401	48.78
2	Wireless Communication Network	158	19.22
3	Wireless Sensor Network	51	6.2
4	Cellular Networks	75	9.1
5	Others	137	16.7

Table 6: The Number of Multiauthors Paper.

Year	Ns	Nm	Ns+Nm	DC
2012	1	146	147	0.993
2013	1	144	145	0.993
2014	3	145	148	0.979
2015	3	145	148	0.979
2016	8	226	234	0.966
Total	16	806	822	0.981

Table 6 shows that there are 806 multi authored papers and only 16 single-authored papers published during the period which shows the predominance of multi authored papers over single authored papers. Degree of collaboration is 0.981. Degree of collaboration is maximum (0.993) in 2012 and 2013 followed by 0.979 in 2014 and 2015 and 0.966 in 2016.

Highly Cited Articles

Citation analysis is helpful to understand the development and growth of research on a particular field. Number of citation received indicates the growth of scholarly articles. In this study it is observed that article “ViNEYard: Virtual Network Embedding Algorithms With Coordinated Note and Link Mapping, 2012, 20(1), pp. 206–219” by Choudhury M, Rahaman M and Boutaba R. received maximum number of citation 211. Seven papers published in 2012 received more than 50 citations, two papers published in 2013 one each in 2014 and 2016 received more than 50 citations.

Sl. No.	Highly Cited Articles During 2012–2016	No. of Citation
1	Choudhury M, Rahaman M and Boutaba R. “ViNEYard: Virtual Network Embedding Algorithms With Coordinated Note and Link Mapping”, 2012, 20(1), 206–219p.	211
2	Lee K, <i>et al.</i> “Mobile Data Offloading: How much Can WiFi Deliver?” 2013, 21(2), 536–550p.	156
3	Ciaraviglio L. <i>et al.</i> “Minimizing ISP Network Energy Cost: Formulation and Solutions”, 2012, 20(2), 463–476p.	116
4	Kim H, <i>et al.</i> “Distributed α Optimal User Association and Cell Load balancing in Wireless Networks”, 2012, 20(1), 177–190p.	111
5	Xie L. “Making Sensor Network Immortal: An Energy Renewal Approach With Wireless Power Transfer”, 2012, 20(6), 1748–1761.	101
6	Deb S, <i>et al.</i> “Algorithms for Enhanced Inter-Cell Interference Coordination (eICIC) in LTE HetNets”, 2014, 22(1), 137–150p.	100
7	Kokku R, <i>et al.</i> “NVS: A Substrate for Virtualizing Wireless Resources in Cellular Networks”, 2012, 20(5), 1333–1346p.	81
8	Liu J, <i>et al.</i> “Generalized Two Hop Relay for Flexible Delay Control in MANETs”, 2012, 20(6), 1950–1963p.	66

9	Lopez-Peez D, “On Distributed and Coordinated Resource Allocation for Interference Mitigation in Self-Organizing LTE Networks”, 2013, 21(4), 1145–1157p.	58
10	Zhang Y, <i>et al.</i> “Data gathering Optimization by Dynamic Sensing and Routing in Rechargeable Sensor Network”, 2016, 24(3), 1632–1646p.	56
11	Wang Y, <i>et al.</i> “Cross Layer Analysis of the End to End Delay Distribution in Wireless Sensor Networks”, 2012, 20(1), 305–318p.	50

FINDINGS AND CONCLUSIONS

From the present study, it has been found that 822 articles were published during the period 2012–2016 with an average of 28.34 per issue. Maximum numbers of 234 articles were published in 2016 with an average of 46.8 per issue, which reveals the recent growth of research in the field of communication and networking. 27321 references were used in 822 articles. Maximum 8194 (35.02%) references were listed in 2016. The study also reveals that most of the papers are multiauthored, only 1.82% of total papers published during the period are single-authored, indicating trend of collaborative research. Degree of collaboration found is 0.981. In case of geographical distribution papers, it has been found that U.S.A. contributed the most followed by China, Italy, Canada, India, France and Israel. Among 822 papers published during the period, 401 articles (48.78%) are on Internet and Computer Networking, 158 (19.22%) on Wireless Networks, 75 papers (9.1%) on Mobile Cellular Networks and 51 papers (6.2%) are on Wireless Sensor Networks which reveals the core areas covered by the journal.

ACKNOWLEDGEMENT

The author is grateful to Asansol Engineering College, Asansol, West Bengal

REFERENCES

1. Nagsarkar S, Veer Chaitanya, Kumbhar Rajendra. Bibliometric Analysis of Papers Published by Faculty of Life Science Departments of Sabitribai Phule Pune University during 1999–2013, *DESIDOC J Libr Inform Technol.* 2015; 35(5): 368–375p.
2. Mishra Devendra Kumar, Gawde Manisha, Solanki Madhu Singh. Bibliometric Study of Ph.D. Thesis in

- English. *Global J Acad Librarianship*. 2014; 1(1): 19–36p.
3. Roy Shanku Bilas, Asak, Moutusi. *Journal of Bibliometrics: A Bibliometric Study, Library Philosophy and Practice* (e-journal). Available from <http://digitalcommons.unl.edu/libphiprac>
 4. Thanuskodi S. Bibliometric Analysis of Indian Journal of Agricultural Research, *Int J Inform Disseminat Technol*. 2012; 2(3): 170–175p.
 5. Tsay Ming-Yueh. A Bibliometric Analysis on the Journal of Information Science, *J Libr Inform Sci Res*. 2011; 5 (2): 1–28p.
 6. Velmurugan C, Radhakrishnan N. Indian Journal of Biotechnology: A Bibliometric Study, *Innovare J Sci*. 2016; 4 (1): 1–7p.
 7. Panda Ipsita, Maharana Bulu, Chhatar Durlav Charan. Journal of Information Literacy: A Bibliometric Study, *Int J Sci Res Pub*. 2013; 3 (3): 1–7p.
 8. Angamanna AMS, Jayatissa LA. A Bibliometric Study of Post Graduate Thesis in Library and Information Science: with Special Reference to University of Kelaniya and University of Colombo, Sri Lanka, *J University Librarians*, 2015; 19(1): 32–53p.
 9. Ambika M. Alwarammal, Chinnadurai D. Bibliometric Study of Annals of Library and Information Studies, *Int J Inform Libr Soc*. 2013; 2(2): 29–33p.
 10. Kumar, Shailendra, Naqvi, Shehbaz Hussain. Collaboration Pattern in the Field of Natural Sciences at Jamia Millia Islamia, New Delhi during 1971–2007, *9th Convention Planner*, Dibrugarh University, Assam, 2014; 23-33p.
 11. Naser Mirza Muhammad, Mahmood Khalid. Use of Bibliometrics in LIS Research, *LIBRES, Libr Inform Sci Res*. 2009; 19(2): 1–11p.

Cite this Article

Bidyut Kumar Patra. IEEE/ACM Transactions on Networking: A Bibliometric Study. *Journal of Advancements in Library Sciences*. 2017, 4(1): 22–28p.