



A Scientometric analysis of multi protocol label switching (MPLS) in Global: 1999 - 2012

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General Note



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ABSTRACT

The study analyses the multi protocol label switching publications in Global for a period of fourteen years (1999-2012) based on the Web of science database. The objective of the study was to perform a scientometric analysis of all multi protocol label switching research publications by Global scientists. The parameters studied include growth of publications and citations, relative growth rate and doubling time, national and international collaboration, highly productive institutions, highly productive authors, highly preferred journals and highly cited publications. A total of 266 publications were published by the Global scientists in multi protocol label switching during 1999-2012 which received 4734 citations. The average number of publications per year was 19.00%. It states that globally 1.65 percents of articles were from single authors, followed by 10.11% authors by double authors etc. 0.98 percent of collaborative authors' articles published during the study periods. Individual contribution is just 1.65 percents in the field of Multi protocol label switching research output. The highest number of publications 27 was published in 2003 and 2008. NTT Corporation topped the list with 17 publications which received 150 citations. Japan is top producing country with 56 publications (21.1%, TLCS 25, TGCS 186).

Keywords: Scientometric study; Protocol; Switching; Networking; Bibliometric study; Citation analysis.

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Abbreviations: BARC - Bhabha Atomic Research Centre; TLCS - Total Local Citation Score; TGCS - Total Global Citation Score; TCR - Total Cited Reference; UAE - United Arab Emirates; DT - Doubling Time; RGR - Relative Growth Rate, MPLS - Multi Protocol Label Switching.

1. INTRODUCTION

We quantitatively study features of multi protocol label switching using the information on sources collected by the Science Citation Index (SCI) from 1999 to 2012. The SCI database has been recognized as the most authoritative scientometrics analysis tool and as a useful supplementary tool in the evaluation of scientific research. In many countries, institutions and researchers are using this data for research performance evaluation. A citation is a reference to a book, article, web page, or other published item (Kademani et al., 2006). Scientometric analysis of 1733 papers published by the teams comprising total of 926 participating scientists at Chemistry Division of Bhabha Atomic Research Centre (BARC) during 1970-1999. Through a survey of academic experts, we asked respondents to rate the top overall journals, business communication journals, technical communication journals, and the top journals from a technology perspective (Raja et al., 2011). Walke et al. (2007) discussed the growth and publications size of the Indian publications in materials science during 1993-2001. It also analyses various other features of publications output such as modes of communication, areas of research priority, research quality, nature of collaboration, and institutional productivity. Das Neves et al. (2007) analyzed the theme "bibliometric studies" published on five Brazilian journals, from 1990 to 2005, particularly the aspects of geographic origin, chronological evolution and thematic orientation. The methodology used was the quantitative-description analysis. The citation analysis thematic, one of the styles of bibliometric studies, is what promotes Brazilian studies on this area since the beginning of the 21st century. Rao et al. (2008) has analyzed the data on distributions of multiple authors in two journals namely, JASIST and Scientometrics. The number of authors per paper in both the journals is increasing; it therefore indicates the trend towards collaboration with more than two authors. i.e., the collaborating nature of research is gradually shifting from 2-authored papers to more than two authors per paper.

Table 1 Authorship pattern

S. No	No of Author	Contribution	Cum.	Percentage (%)
1	Single Authors	18	18	1.655934
2	Double Authors	110	128	10.1196
3	Three Authors	201	329	18.49126
4	Four Authors	204	533	18.76725
5	Five Authors	110	643	10.1196
6	Six Authors	126	769	11.59154
7	Seven Authors	126	895	11.59154
8	Eight Authors	24	919	2.207912
9	Nine Authors	27	946	2.483901
10	Ten Authors	20	966	1.839926
11	More than 10 authors	121	1087	11.13155
Total	-	1087	-	100

Table 2 Shows authorship pattern of degree of collaboration

	Contribution	Cum.	Percentage (%)
Single	18	18	1.655934
Multi	1069	1087	98.35166
Total	1087	-	100
Degree of Collaboration			0.983441

Table 3 Relative growth rate and doubling time

Publication year	Records	Percent	Cum	W1	W2	RGR	Doubling time
1999	2	0.8	2	-	0.693147	0.693147	0.999788
2000	11	4.1	13	0.693147	2.564949	1.871802	0.370231
2001	13	4.9	26	2.564949	3.258097	0.693147	0.999788
2002	25	9.4	51	3.258097	3.931826	0.673729	1.028603
2003	27	10.2	78	3.931826	4.356709	0.424883	1.631037
2004	31	11.7	109	4.356709	4.691348	0.334639	2.070888
2005	21	7.9	130	4.691348	4.867534	0.176187	3.93333
2006	26	9.8	156	4.867534	5.049856	0.182322	3.800977
2007	24	9	180	5.049856	5.192957	0.143101	4.842739
2008	27	10.2	207	5.192957	5.332719	0.139762	4.958431
2009	14	5.3	221	5.332719	5.398163	0.065444	10.58922
2010	14	5.3	235	5.398163	5.459586	0.061423	11.28245
2011	19	7.1	254	5.459586	5.537334	0.077749	8.913326
2012	12	4.5	266	5.537334	5.583496	0.046162	15.01233

states that globally 1.65 percents of articles were from single authors, followed by 10.11% authors by double authors etc. There is general decrease in Raja et al.

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2. STATEMENT OF THE PROBLEM

The present study pointing out of analyzing the research output performance of Multi Protocol Label Switching in Indian perspective. In academic and scientific work, publication means of communicating research, primarily of recognition and reward and central social process in the Universities. Hence publication is a social norm in a public sense and serves as a tool for the betterment of the individuals. After the publication, it can be called as research and can be fixed or judged and acknowledged by the scientists in the society.

2.1. Scope of the study

The study is to find out the information about the recent communication trends in the advancement of the field of Multidisciplinary subject a citation analysis "Multi Protocol Label Switching" and for this purpose, the study is based on articles in journals, authors published the books and papers published in conference proceedings published on Multi Protocol Label Switching subject from 1999 to 2012 Using statistical techniques like histogram charts, bar charts etc, these will be used to interpret the data.

2.2. Limitations of the study

- The study undertaken is limited to 14 years, i.e. 1999-2012.
- It is a small scale study, which may need to be indicated by the states.
- Here we did Citation analysis of tertiary source of information
- In this study we did not include the citation analysis on patents.

2.3. Data collection

The publications of Multi-protocol label switching (MPLS) are mostly in the form of primary Journals, Notes, Letters, reviews, Editorial-materials, Meeting-abstracts, Bibliographic-items and Discussions. The research papers published by web of science in the field of Science and Technology covered and index database were taken as the prime source for the present study. The bibliographical details of publications were entered in the catalogue cards. Finally the cards were arranged in different ways with a view to identify the research performance of faculty Members.

3. RESULTS AND DISCUSSION

3.1. Authorship Pattern

Table 1 and Fig.1 shows the number of authors and their corresponding publications. Lotka's Law, an inverse, square law, is used to find authors productivity patterns. It

performance among a body of authors following $1:n^2$. This ratio shows that some produce much more than the average. According to Lotka's law of scientific productivity, only 11.13 percent of the authors in a field will produce more than 10 articles. The general form of Lotka's law can be expressed as: $y = c/x^n$. The results depict that majority of papers are Multi authored. It clearly brings out collaborative research in the field. It clearly brings out multi investigation is high compare than individual research in the field of multi protocol label switching.

Table 4 Author's wise document distribution

S. No	Author	Records	Percent	TLCS	TLCS/t	TLCSx	TGCS	TGCS/t	TLCR	TLCSb	TLCSe
1	Oki E	12	4.5	18	1.84	11	164	16.74	5	10	0
2	Shiomoto K	8	3.0	17	1.59	11	155	14.40	4	10	0
3	Yamanaka N	8	3.0	17	1.59	11	154	14.19	4	10	1
4	Imajuku W	7	2.6	17	1.72	8	111	12.63	5	11	0
5	Ji YF	6	2.3	2	0.67	0	9	2.40	3	0	0
6	Martinez R	6	2.3	4	1.50	0	11	3.17	3	0	0
7	Castoldi P	5	1.9	0	0.00	0	0	0.00	0	0	0
8	Colle D	5	1.9	5	0.54	3	18	2.33	4	1	0
9	Junyent G	5	1.9	3	1.00	0	12	3.17	3	0	0
10	Lu YM	5	1.9	2	0.67	0	7	2.07	3	0	0
11	Munoz R	5	1.9	4	1.50	0	8	2.83	3	0	0
12	Okamoto S	5	1.9	13	1.18	7	104	10.05	2	8	0
13	Pickavet M	5	1.9	5	0.54	3	18	2.33	4	1	0
14	Wei W	5	1.9	1	0.11	0	16	1.83	13	1	0
15	Casellas R	4	1.5	4	1.50	0	7	2.67	2	0	0
16	Choi JK	4	1.5	1	0.10	0	15	1.40	1	1	0
17	Matera F	4	1.5	0	0.00	0	4	0.57	2	0	0
18	Mohan G	4	1.5	4	0.69	4	18	2.61	0	1	0
19	Sone Y	4	1.5	4	0.54	1	11	3.38	5	3	0
20	Spadaro S	4	1.5	3	1.00	0	13	3.25	0	0	0

that multi author contributed papers maintained the high profile among Multi protocol label switching research scientists.

Table 5 Journal wise document distribution

S.No	Journal	Records	Percent	TLCS	TLCS/t	TGCS	TGCS/t	TLCR
1	IEICE Transactions on Communications	34	12.8	13	1.79	73	8.72	12
2	Computer Communications	21	7.9	5	0.81	72	8.34	4
3	Photonic Network Communications	20	7.5	8	0.83	97	11.49	11
4	Computer Networks	12	4.5	2	0.29	47	7.01	2
5	Journal of Optical Communications and Networking	9	3.4	3	1.00	14	5.42	2
6	Fiber and Integrated Optics	8	3.0	2	0.20	10	1.17	1
7	NEC Research & Development	8	3.0	0	0.00	2	0.18	0
8	IEEE Communications Magazine	7	2.6	13	1.18	133	13.43	0
9	IEEE Journal on Selected Areas in Communications	7	2.6	8	0.96	114	13.43	0
10	Journal of Communications and Networks	7	2.6	0	0.00	7	0.90	4
11	Computer Networks-the International Journal of Computer and Telecommunications Networking	6	2.3	0	0.00	35	3.19	1
12	Ieee Communications Letters	6	2.3	3	0.43	63	8.07	0
13	Chinese Optics Letters	5	1.9	2	0.67	7	2.00	3
14	BT Technology Journal	4	1.5	1	0.13	24	2.84	0
15	ETRI Journal	4	1.5	1	0.13	16	1.58	0
16	European Transactions on Telecommunications	4	1.5	1	0.20	2	0.40	3
17	Journal of Lightwave Technology	4	1.5	0	0.00	82	6.54	0
18	Journal of the Communications Network	4	1.5	0	0.00	12	1.40	1
19	Annales Des Telecommunications-Annals of Telecommunications	3	1.1	0	0.00	1	0.25	1
20	European Journal of Operational Research	3	1.1	0	0.00	2	0.40	0

3.4. Author's wise document distribution

The most productive author is Oki E with 12 papers dealing with multi protocol label switching and each 4.5% TLCS 18, TGCS 164, TLCR 5 of all papers published in this research field. The authors of the seminal publication on multi protocol label switching given Table 6.4 Shiomoto K 8 (3.0%), TLCS 17, TGCS 155, TLCR 4 and Yamanaka N (3.0%), TLCS 17, TGCS 154, TLCR 4, appear on rank 2, respectively. It can be clearly visualized from the Table 4.

3.5. Journal wise document distribution

The most productive Journal is IEICE Transactions on Communications with 34 papers dealing with multi protocol label switching and 12.8%, TLCS 13, TGCS 73, TLCR 12 of all papers published in this research field. The journal of the seminal publication on multi protocol label switching given table 6.5, Computer Communications and Photonic Network Communications, appear on rank 2 (7.9%), TLCS 5, TGCS 72, TLCR 4 and 3 (7.5%), TLCS 8, TGCS 97, TLCR 11 respectively were shown in Table 5.

3.2. Degree of Collaboration

The authorship pattern analyzed to determine the percentage of single and multi-authorship is denoted in Table 2. The extended of collaboration in research can be measured with the help of multi authored papers using in the formula given by subramaniyam (1982)

Degree of collaboration $C = Nm/Nm + Ns$

C = Degree of collaboration

Nm = Number of Multiple authors

Ns = Number of Single authors

Based on this study, the result of the degree of collaboration $C = 0.98$, i.e., 0.98 percent of collaborative authors' articles published during the study periods. Individual contribution is just 1.65 percents in the field of Multi protocol label switching research output. Multi author's contribution is 198.35 percents of the Multi protocol label switching research output. The study interpreted

3.3. Relative growth rate and doubling time

Relative Growth Rate (RGR) is the increase in number of publications per unit of time. There exists a direct relation between the relative growth rate and the doubling time. The relative growth rate and doubling time of publications have been presented in Table 3. Fig.2 indicates the value of an average RGR of publications which decreased from 1.87 in 2000 to 0.04 in 2012. Simultaneously, the values of doubling time (Dt) of publications increased from 0.99 in 1999 to 15.01 in 2012.

Table 6 Word wise distribution of documents

S. No	Publication year	Records	Percent	TLCS	TGCS
1	Networks	122	45.9	31	426
2	MPLS	72	27.1	10	164
3	Optical	55	20.7	6	207
4	Based	51	19.2	21	227
5	GMPLS	50	18.8	27	227
6	Multi	48	18.0	11	122
7	Network	46	17.3	9	121
8	Routing	33	12.4	7	154
9	Traffic	32	12.0	18	197
10	Path	28	10.5	7	96
11	Protocol	27	10.2	2	85
12	Label	25	9.4	3	127
13	Switching	24	9.0	1	129
14	Control	23	8.6	9	97
15	Engineering	23	8.6	18	191
16	Protection	20	7.5	11	139
17	QOS	20	7.5	4	36
18	Scheme	20	7.5	11	91
19	Service	20	7.5	2	80
20	WDM	20	7.5	8	163

Table 7 Year wise distribution of documents

S. No	Publication year	Records	Percent	TLCS	TGCS
1	1999	2	0.8	0	2
2	2000	11	4.1	3	115
3	2001	13	4.9	2	70
4	2002	25	9.4	18	253
5	2003	27	10.2	10	217
6	2004	31	11.7	7	67
7	2005	21	7.9	9	51
8	2006	26	9.8	4	77
9	2007	24	9.0	4	68
10	2008	27	10.2	5	50
11	2009	14	5.3	1	16
12	2010	14	5.3	5	14
13	2011	19	7.1	1	15
14	2012	12	4.5	0	0

3.6. Word wise distribution of documents

The high frequency keywords will enable us to understand the various aspects of multi protocol label switching under study. The high frequency keywords were: Networks 122 (45.9%, TLCS 31, TGCS 426), MPLS 72 (27.1%, TLCS 10, TGCS 164), Optical 55 (20.7 %, TLCS 6, TGCS 207), Based 51 (19.2%, TLCS 21, TGCS 227) and GMPLS 50 (18.8%, TLCS 27, TGCS 227). Analysis of the keywords appeared either on the title or assigned by the indexer or the author himself will help in knowing in which direction the knowledge grows (Table 6).

3.7. Year wise distribution of documents

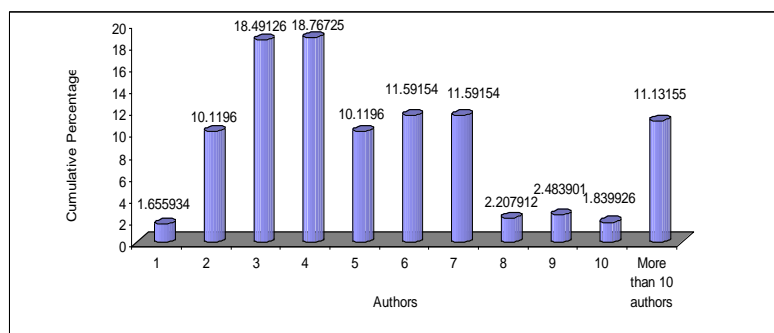
During 1999 - 2012 a total of 266 publications were published in multi protocol label switching by global. The average Number of Publications produced per year was 19.00 %. The highest number of publications 27 was produced in 2003 and 2008 Table 7 was given year wise growth and collaboration rate in multi protocol label switching. It can be clearly visualized from the Fig.3 that growth of the literature was very low during 1999. It Indicate that research in multi protocol label switching received a major impetus this period.

3.8. Source wise distribution documents

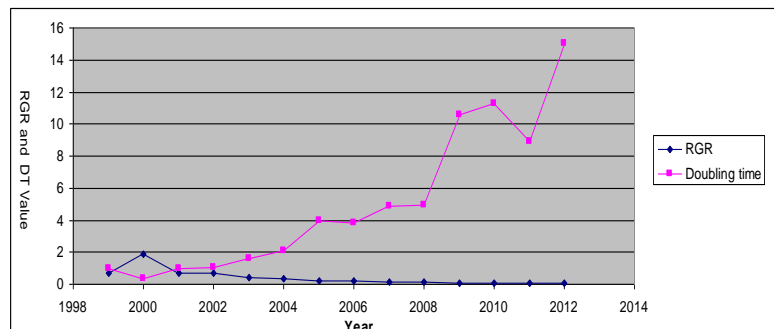
Multi protocol label switching Scientists communicated their research results through a variety of communication channels. Table 8 provides the distribution of publications in various channels of communication. It was observed that 80.5 percent of the literature was published in Article followed by 18.8 percent in Proceedings Paper and 0.8 percent in Review.

3.9. Institution wise distribution documents

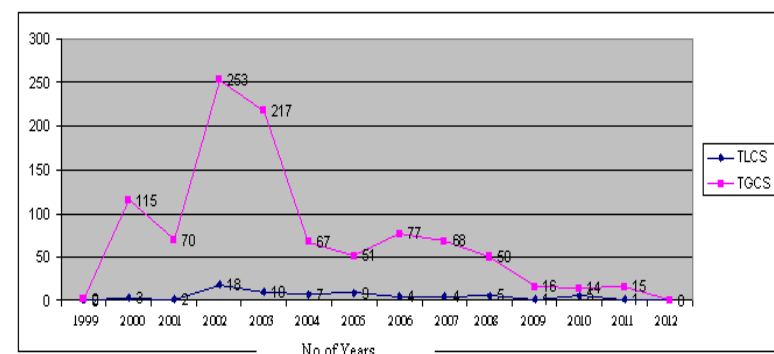
There were 274 institutions involved in research activity in the field of multi protocol label switching. Table 9 provides publication productivity of top 20 institutions. NTT Corporation topped the list with 17 publications (6.4 %, TLCS 20, TGCS 130) followed by Unknown with 10 publications (3.8 %, TLCS 0, TGCS 29), respectively.

**Figure 1**

Authorship pattern

**Figure 2**

Relative growth rate and doubling time.

**Figure 3**

Year wise distribution of documents

Table 8 Source wise distribution documents

S. No	Document Type	Records	Percent	TLCS	TGCS
1	Article	214	80.5	62	857
2	Proceedings Paper	50	18.8	7	154
3	Review	2	0.8	0	4

Table 10 Country wise documents distribution

S. No	Country	Records	Percent	TLCS	TGCS
1	Japan	56	21.1	25	186
2	USA	42	15.8	14	402
3	Peoples R China	30	11.3	5	57
4	Unknown	28	10.5	5	132
5	Canada	22	8.3	4	53
6	Italy	19	7.1	1	15
7	Spain	16	6.0	4	29
8	South Korea	12	4.5	1	20
9	Taiwan	11	4.1	0	82
10	Belgium	10	3.8	5	30
11	Singapore	8	3.0	4	20
12	Germany	5	1.9	0	3
13	UK	5	1.9	1	61
14	Denmark	4	1.5	0	3
15	France	4	1.5	0	38
16	Sweden	4	1.5	1	4
17	Hungary	3	1.1	2	8
18	India	3	1.1	1	3
19	Switzerland	3	1.1	1	49
20	Croatia	2	0.8	0	0
21	Egypt	2	0.8	0	0
22	Malaysia	2	0.8	0	3
23	Morocco	2	0.8	0	2
24	Pakistan	2	0.8	0	0
25	Poland	2	0.8	0	0
26	Portugal	2	0.8	0	8
27	South Africa	2	0.8	1	7
28	Argentina	1	0.4	0	3
29	Austria	1	0.4	0	1
30	Brazil	1	0.4	0	3
31	Colombia	1	0.4	0	0
32	Cyprus	1	0.4	0	1
33	Finland	1	0.4	0	0
34	Greece	1	0.4	0	10
35	Iran	1	0.4	0	3
36	Jordan	1	0.4	0	1
37	Mexico	1	0.4	0	3
38	New Zealand	1	0.4	0	4
39	Turkey	1	0.4	0	0

2001, 3031 IETF RFC with 18(6.8 %). Scientometric studies enable the science policy makers and administrators to understand and grasp the growth, development and impact of research and to know the countries, institutions and the individual scientists who are active in a particular field of research activity.

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REFERENCES

1. Das Neves, Machado, Raymundo. Análise cientométrica dos estudos bibliométricos publicados em periódicos da área de biblioteconomia e ciência da informação (1990-2005). (Portuguese) *Perspectivas em Ciência da Informação*, 2007, 12(3), 2-20
2. Kademani BS, Kumar Vijai, Sagar Anil, Kumar Anil, Mohan Lalit, Surwase Ganesh. Scientometric dimensions of thorium research in India. *DESIDOC Bulletin of Info. Technol.*, 2006, 26(3), 9-25
3. Raja S, Ramkumar P, Viji P. Scientometric dimension on gender in worldwide thyroid cancer: A study based on web of science database. *Indi. J. Sci. & Technol.*, 2011, 4(4), 425-428
4. Rao IK, Sahoo Bibhuti Bhusan. Distributions of multiple authors: A case study of two journals (JASIST & Scientometrics). *Collnet J. Scientometrics & Info. Managnt.*, 2008, 2(1), 27-36
5. Walke, Rajpal, Dhawan SM. Materials science research in India: A scientometric analysis. *DESIDOC Bulletin of Info. Technol.*, 2007, 27(1), 69-76

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3.10. Country wise documents distribution

There were as many as 39 countries carrying out research in the field of multi protocol label switching. Table 10 provides a list of collaboration countries whose research output is more than 50 publications. Japan is top producing country with 56 publications (21.1%, TLCS 25, TGCS 186) followed by USA with 42 publications (15.8%, TLCS 14, TGCS 402), Peoples R China with 30 Publications (11.3%, TLCS 5, TGCS 57), respectively.

Table 9 Institution wise distribution documents

S. No	Institution	Records	Percent	TLCS	TGCS
1	NTT Corporation	17	6.4	20	130
2	Unknown	10	3.8	0	29
3	Beijing University Posts & Telecommunication	9	3.4	3	9
4	NEC Corporation Ltd	9	3.4	0	3
5	KDDI R&D Labs Inc	7	2.6	1	3
6	University Ottawa	7	2.6	0	16
7	Scuola Super Sant Anna	6	2.3	0	3
8	Shanghai Jiao Tong University	6	2.3	1	18
9	University Politecn Cataluna	6	2.3	3	11
10	CTTC	5	1.9	4	8
11	Keio University	5	1.9	0	5
12	National University Singapore	5	1.9	4	18
13	University Electrocommunication	5	1.9	1	8
14	ETRI	4	1.5	1	13
15	Fdn Ugo Bordoni	4	1.5	0	4
16	Northeastern University	4	1.5	0	5
17	Osaka University	4	1.5	1	6
18	University Waterloo	4	1.5	3	11
19	Bell Labs	3	1.1	0	20
20	CNIT	3	1.1	0	0

3.11. Cited reference wise documents distribution

The most cited reference is Rosen E., 2001, 3031 IETF RFC with 18 papers dealing with multi protocol label switching 6.8 % of all papers published in this research field. The cited reference of the seminal publication on multi protocol label switching given Table 11, appear on rank 2 & 3 Banerjee A, 2001, IEEE COMMUN MAG, V39, P144, DOI 10.1109/35.933450 and Zang H., 2000, OPTICAL NETWORKS MAG, V1, P47 respectively. It can be clearly visualized from the Table 11.

4. CONCLUSION

This paper has analyzed 266 publications on multi protocol label switching and cited in the web of science database during 1999-2012. It states that globally 1.65 percents of articles were from single authors. 0.98 percent of collaborative authors' articles published during the study periods. Individual contribution is just 1.65 percents in the field of Multi protocol label switching research output. Multi author's contribution is 198.35 percents output. The most productive author is Oki E with 12 papers dealing with multi protocol label switching of all papers published in this research field and most productive Journal is IEICE Transactions on Communications with 34 papers dealing with multi protocol label switching 12.8%, TLCS 13, TGCS 73, TCCR 12 in this research field. The high frequency keywords were "Networks" 122 (45.9%, TLCS 31, TGCS 426). The highest number of publications 27 were produced in 2003 and 2008 and very low during 1999. NTT Corporation topped the list compare to other institution. Japan is top producing country with 56 publications (21.1%, TLCS 25, TGCS 186). The most cited reference is Rosen E.,