Logoot

a Scalable Optimistic Replication Algorithm for Collaborative Editing on P2P Networks

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Introduction

- Collaborative editing

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- Wikipedia

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  - 10 million of articles
  - Centralized infrastructure

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- Solution ?
  - Peer-to-peer

P2P

Peer-to-Peer constraint

- Churn - Peers which enter and leave the network
- Unknow/unbouded set of peer

Collaborative and real-time editor must insure the CCI :

P2P

Peer-to-Peer constraint

- Churn - Peers which enter and leave the network
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Collaborative and real-time editor must insure the CCI :

- Causality : Ensure all operations are ordered
- Convergence : Convergence of the system when idle
- Intention : Expected effect observed on all replica
- Scalability : Must handle addition of users or objects

Related Work

- WOOKI : Hasse diagramm extension
  - P2P system
  - Barely respect CCI
  - Use tombstones

Related Work

- WOOKI : Hasse diagramm extension
  - P2P system
  - Barely respect CCI
  - Use tombstones
- TreeDoc : Binary tree
  - P2P system
  - Use tombstones
  - Proposed procedure to remove tombstones but cannot be used in P2P

Proposition

- Logoot
  - Linear structure
  - Total order between elements
  - Any element (line) as an unique identifier
- Two operations
  - Insert(pid,text)
  - Delete(pid)

Logoot model - Identifier

Identifier

- Couple (pid, content)
- $pid = pid_1.pid_2...pid_n.(pos, site)$
- Total order :
  - $(1,1) < (1,3)$
  - $(1,1)(5,2) < (1,1)(14,1) < (4,2)$

Logoot model - Identifier

- *(0,0)* - Begining of the document

- *(MAX,0)* - End of the document

Logoot model - Identifier

- *(0,0)* - Begining of the document
- *(1,1),0* - Line 1 insered

- *(MAX,0)* - End of the document

Logoot model - Identifier

- *(0,0)* - Begining of the document
- *(1,1),0* - Line 1 insered

- *(1,3),2* - Line 2 insered
- *(MAX,0)* - End of the document

Logoot model - Identifier

- *(0,0)* - Begining of the document
- *(1,1),0* - Line 1 insered
- *(1,1)(1,5),4* - Line 3 insered between line 1 and line 2
- *(1,3),2* - Line 2 insered
- *(MAX,0)* - End of the document

Logoot model - Modifying and Integrating

- Modifying
  - Generate one or more identifier
  - Postion can become bigger
- Integration
  - Binary search
  - Logarithmic time
  - Deletion doesn't need tombstone to insure convergence

Result

- Methodology
  - Wooto, TreeDoc and Logoot
  - Most edited encyclopedic pages
  - Most edited pages
  - Biggest pages
  - Over the last 100 edits
- Observation of overhead

Result

Experimentation : Most edited encyclopedic pages

	Pages	Overhead (in percent)			Number of Patches	Size (in bytes)
		Logoot	Wooto	TreeDoc		
1	George W. Bush	8.33	16128.75	14590.79	41563	133146
2	List of World Wrestling Entertainment employees	39.24	8413.41	6310.05	27152	16673
3	United States	8.30	5875.07	4406.31	24781	158242
4	Jesus	9.83	4179.09	3134.32	20271	125669
5	2006 Lebanon War	13.62	927.12	695.34	17780	139458
6	Islam	15.92	2996.30	2247.22	15315	101278
7	Roman Catholic Church	5.92	1129.51	847.13	14378	170380
8	Deaths in 2006	18.51	1747.24	1310.43	14029	21880
9	Canada	17.88	4431.19	3323.39	13992	112589
10	Akatsuki (Naruto)	9.81	389.89	292.42	13929	60638
	Average	14.74	4621.76	3715.74	20319	106639

Result

Experimentation : Most edited pages

	Pages	Overhead (in percent)			Number of Patches	Size (in bytes)
		Logoot	Wooto	TreeDoc		
1	Wikipedia: Administrator intervention against vandalism	27.78	287530.03	215647.52	438330	2369
2	Wikipedia: Reference desk/Miscellaneous	520.21	7492.31	5619.23	148283	133204
3	Wikipedia: Reference desk/Science	186.14	3431.45	2573.59	142722	190858
4	Wikipedia: Introduction	43.74	4195621.30	3146715.98	132693	317
5	Wikipedia: Help desk	58.11	9266.41	6949.81	126509	96256
	Average	167.20	900668.3	675501.23	197707	1011.98

Result

Experimentation : Biggest pages

	Pages	Overhead (in percent)			Number of Patches	Size (in bytes)
		Logoot	Wooto	TreeDoc		
1	Line of succession to the British throne	23.65	488.30	366.23	3317	376760
2	United States at the 2008 Summer Olympics	52.65	314.71	236.03	2314	314748
3	List of sportspeople by nickname	19.14	82.34	61.75	2332	309576
4	List of Brazilian football transfers 2008	27.08	11.33	8.5	752	287128
5	List of college athletic programs by U.S. State	34.60	48.56	36.42	868	305294
6	List of Chinese inventions	5.11	37.71	28.29	2344	293228
7	List of suicide bombings in Iraq since 2003	13.51	24.55	18.42	1260	215763
8	China at the 2008 Summer Olympics	61.55	134.15	100.61	1552	268720
9	List of urban areas in Sweden	40.04	39.61	29.71	19	108353
10	Table of United States Core Based Statistical Areas	63.55	61.54	46.15	31	252236
	Average	34.09	124.28	93.21	1478.9	320899

Result

Logoot observation :

- Relative overhead seem constant
- Way better when number of patch > 10.000
- A little better when number of patch < 2.000

Why ?

- No tombstones to maintain order
- A lot of deletion (Update = Delete + Insert)

Conclusion

- Logoot ensure the CCI on P2P network
- It does not require tombstones
- Space overhead remains linear
- Better performances than WOOT and Treedoc