MP2.2 Design Document: Highly Available and Scalable Tiny SNS

Overview

TinySNS is a simple social networking service that allows users to perform basic social interactions such as creating accounts, following and unfollowing other users, and viewing timelines. The service is designed to be distributed across multiple clusters with a coordinator responsible for managing the clusters and ensuring synchronization among them.

Components

1. Coordinator

The coordinator in TinySNS takes on the pivotal roles of managing clusters, assigning master servers, and overseeing synchronization. Implemented in the coordinator.cc file, it provides three essential functions: GetServer retrieves information about the master server in a cluster, dynamically selecting a new master if none is found; GetSlave obtains information about a non-master server in a cluster, and GetSynchronizer retrieves information about a synchronizer in a cluster. These functions collectively enable the coordinator to efficiently orchestrate server roles, ensuring the seamless operation and synchronization of the TinySNS social networking service.

2. Synchronizer

The synchronizer plays a critical role in TinySNS by ensuring the synchronization of data across clusters. Operating in a continuous loop, it periodically synchronizes user data, follow relationships, and timelines with the coordinator. The synchronizer exposes key functionalities, including sync_all_user, which harmonizes the list of all users across clusters; sync_follow, responsible for synchronizing follow relationships among users; and sync_timeline, ensuring the synchronization of user timelines. These functions collectively contribute to maintaining consistency and coherence in user interactions and content across the distributed environment of the TinySNS social networking service.

3. TSC (TinySNS Client)

TSC is the client-side implementation responsible for interacting with the TinySNS service. It communicates with the coordinator to obtain information about servers and synchronizers. It also implements user commands like login, follow, unfollow, listing followed users, and viewing timelines.

4. TSD (TinySNS Server)

TSD is the server-side implementation responsible for handling user requests received from the TSC. It communicates with the coordinator to obtain information about the server it belongs to and synchronizers in the cluster. It implements user commands such as login, follow, unfollow, listing followed users, and viewing timelines.

Working:

1. The TSD server registers itself with the coordinator upon startup, indicating its cluster, type, and availability.
2. Users interact with the TSC client to perform actions like logging in, following/unfollowing users, listing followed users, and viewing timelines.
3. The TSC client communicates with the coordinator to obtain information about servers or synchronizers as needed.
4. The TSD server receives user requests from the TSC client and communicates with the coordinator for cluster-related information.
5. The synchronizer periodically runs synchronization processes to ensure data consistency across clusters.

Test Cases Output

Run make clean first and then make for each and every test cases.

Test case 1

Go to the project directory from your terminal window.

Run the below commands in different terminal tabs.

- ./coordinator -p 9000
- ./tsd -c 1 -s 1 -h localhost -k 9000 -p 10000
- ./tsd -c 1 -s 2 -h localhost -k 9000 -p 10001
- ./tsc -h localhost -k 9000 -u 1
- ./tsc -h localhost -k 9000 -u 4

Screenshots
Client 1

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```
csce662@csce662:~/MP2.2$ ./tsc -h localhost -k 9000 -u 1

========= TINY SNS CLIENT =========
 Command Lists and Format:
 FOLLOW <username>
 UNFOLLOW <username>
 LIST
 TIMELINE
======================================
Cmd> LIST
Command completed successfully
All users: 1, 4,
Followers:
Cmd> FOLLOW 4
Command completed successfully
Cmd> LIST
Command completed successfully
All users: 1, 4,
Followers: 4,
Cmd> TIMELINE
Command completed successfully
Now you are in the timeline
p11
p12
4 (Fri Nov 24 20:48:40 2023) >> p41
4 (Fri Nov 24 20:48:42 2023) >> p42
▯
```

Client 2

```
csce662@csce662:~/MP2.2$ ./tsc -h localhost -k 9000 -u 4

========= TINY SNS CLIENT =========
 Command Lists and Format:
 FOLLOW <username>
 UNFOLLOW <username>
 LIST
 TIMELINE
====================================
Cmd> LIST
Command completed successfully
All users: 1, 4,
Followers:
Cmd> FOLLOW 1
Command completed successfully
Cmd> LIST
Command completed successfully
All users: 1, 4,
Followers: 1,
Cmd> TIMELINE
Command completed successfully
Now you are in the timeline
1 (Fri Nov 24 20:48:32 2023) >> p12
1 (Fri Nov 24 20:48:30 2023) >> p11
p41
p42
[]
```

Test case 2

Go to the project directory from your terminal window.

Run the below commands in different terminal tabs.

- ./coordinator -p 9000
- ./tsd -c 1 -s 1 -h localhost -k 9000 -p 10000
- ./tsd -c 1 -s 2 -h localhost -k 9000 -p 10001
- ./tsd -c 2 -s 1 -h localhost -k 9000 -p 20000
- ./tsd -c 2 -s 2 -h localhost -k 9000 -p 20001
- ./tsd -c 3 -s 1 -h localhost -k 9000 -p 30000
- ./tsd -c 3 -s 2 -h localhost -k 9000 -p 30001
- ./synchronizer -h localhost -k 9000 -p 9001 -i 1
- ./synchronizer -h localhost -k 9000 -p 9002 -i 2
- ./synchronizer -h localhost -k 9000 -p 9003 -i 3

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- ./tsc -h localhost -k 9000 -u 1
- ./tsc -h localhost -k 9000 -u 2
- ./tsc -h localhost -k 9000 -u 3

Screenshots

Client 1

```
csce662@csce662:~/MP2.2$ ./tsc -h localhost -k 9000 -u 1

========= TINY SNS CLIENT =========
 Command Lists and Format:
 FOLLOW <username>
 UNFOLLOW <username>
 LIST
 TIMELINE
===================================
Cmd> LIST
Command completed successfully
All users: 2, 3, 1,
Followers:
Cmd> FOLLOW 2
Command completed successfully
Cmd> FOLLOW 3
Command completed successfully
Cmd> LIST
Command completed successfully
All users: 2, 3, 1,
Followers: 3, 2,
Cmd> TIMELINE
Command completed successfully
Now you are in the timeline
p11
p12
2 (Fri Nov 24 20:08:35 2023) >> p21
2 (Fri Nov 24 20:08:36 2023) >> p22
3 (Fri Nov 24 20:09:53 2023) >> p31
3 (Fri Nov 24 20:09:54 2023) >> p32
▯
```

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Client 2

```
csce662@csce662:~/MP2.2$ ./tsc -h localhost -k 9000 -u 2

========= TINY SNS CLIENT =========
 Command Lists and Format:
 FOLLOW <username>
 UNFOLLOW <username>
 LIST
 TIMELINE
===================================
Cmd> LIST
Command completed successfully
All users: 3, 1, 2,
Followers:
Cmd> FOLLOW 1
Command completed successfully
Cmd> FOLLOW 3
Command completed successfully
Cmd> LIST
Command completed successfully
All users: 3, 1, 2,
Followers: 3, 1,
Cmd> TIMELINE
Command completed successfully
Now you are in the timeline
1 (Fri Nov 24 20:06:33 2023) >> p12
1 (Fri Nov 24 20:06:32 2023) >> p11
p21
p22
3 (Fri Nov 24 20:09:53 2023) >> p31
3 (Fri Nov 24 20:09:54 2023) >> p32
```

Client 3

```
csce662@csce662:~/MP2.2$ ./tsc -h localhost -k 9000 -u 3

========= TINY SNS CLIENT =========
 Command Lists and Format:
 FOLLOW <username>
 UNFOLLOW <username>
 LIST
 TIMELINE
===================================
Cmd> LIST
Command completed successfully
All users: 1, 2, 3,
Followers:
Cmd> FOLLOW 1
Command completed successfully
Cmd> FOLLOW 2
Command completed successfully
Cmd> LIST
Command completed successfully
All users: 1, 2, 3,
Followers: 1, 2,
Cmd> TIMELINE
Command completed successfully
Now you are in the timeline
2 (Fri Nov 24 20:08:36 2023) >> p22
2 (Fri Nov 24 20:08:35 2023) >> p21
1 (Fri Nov 24 20:06:33 2023) >> p12
1 (Fri Nov 24 20:06:32 2023) >> p11
p31
p32
```

Test case 3

Go to the project directory from your terminal window.

Run the below commands in different terminal tabs.

- ./coordinator -p 9000
- ./tsd -c 1 -s 1 -h localhost -k 9000 -p 10000
- ./tsd -c 1 -s 2 -h localhost -k 9000 -p 10001
- ./tsd -c 2 -s 1 -h localhost -k 9000 -p 20000
- ./tsd -c 2 -s 2 -h localhost -k 9000 -p 20001
- ./tsd -c 3 -s 1 -h localhost -k 9000 -p 30000
- ./tsd -c 3 -s 2 -h localhost -k 9000 -p 30001

- ./synchronizer -h localhost -k 9000 -p 9001 -i 1
- ./synchronizer -h localhost -k 9000 -p 9002 -i 2
- ./synchronizer -h localhost -k 9000 -p 9003 -i 3
- ./tsc -h localhost -k 9000 -u 1
- ./tsc -h localhost -k 9000 -u 2
- ./tsc -h localhost -k 9000 -u 3

Screenshots

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Client 1

```
csce662@csce662:~/MP2.2$ ./tsc -h localhost -k 9000 -u 1

========= TINY SNS CLIENT =========
 Command Lists and Format:
 FOLLOW <username>
 UNFOLLOW <username>
 LIST
 TIMELINE
====================================
Cmd> LIST
Command completed successfully
All users: 2, 3, 1,
Followers:
Cmd> FOLLOW 2
Command completed successfully
Cmd> FOLLOW 3
Command completed successfully
Cmd> LIST
Command completed successfully
All users: 2, 3, 1,
Followers: 3, 2,
Cmd> TIMELINE
Command completed successfully
Now you are in the timeline
p11
p12
2 (Fri Nov 24 20:08:35 2023) >> p21
2 (Fri Nov 24 20:08:36 2023) >> p22
3 (Fri Nov 24 20:09:53 2023) >> p31
3 (Fri Nov 24 20:09:54 2023) >> p32
^Z
[1]+  Stopped                 ./tsc -h localhost -k 9000 -u 1
csce662@csce662:~/MP2.2$ ./tsc -h localhost -k 9000 -u 1

========= TINY SNS CLIENT =========
 Command Lists and Format:
 FOLLOW <username>
 UNFOLLOW <username>
 LIST
 TIMELINE
====================================
Cmd> FOLLOW 5
Command completed successfully
Cmd> LIST
Command completed successfully
All users: 5, 2, 3, 1,
Followers: 5, 2, 3,
Cmd> TIMELINE
Command completed successfully
Now you are in the timeline
2 (Fri Nov 24 20:24:08 2023) >> p24
2 (Fri Nov 24 20:24:06 2023) >> p23
3 (Fri Nov 24 20:22:55 2023) >> p34
3 (Fri Nov 24 20:22:54 2023) >> p33
5 (Fri Nov 24 20:21:29 2023) >> p52
5 (Fri Nov 24 20:21:27 2023) >> p51
3 (Fri Nov 24 20:09:54 2023) >> p32
3 (Fri Nov 24 20:09:53 2023) >> p31
2 (Fri Nov 24 20:08:36 2023) >> p22
2 (Fri Nov 24 20:08:35 2023) >> p21
p13
p14
5 (Fri Nov 24 20:28:18 2023) >> p53
5 (Fri Nov 24 20:28:20 2023) >> p54
```

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Client 2


```
csce662@csce662:~/MP2.2$ ./tsc -h localhost -k 9000 -u 2

========= TINY SNS CLIENT =========
 Command Lists and Format:
 FOLLOW <username>
 UNFOLLOW <username>
 LIST
 TIMELINE
===================================
Cmd> LIST
Command completed successfully
All users: 3, 1, 2,
Followers:
Cmd> FOLLOW 1
Command completed successfully
Cmd> FOLLOW 3
Command completed successfully
Cmd> LIST
Command completed successfully
All users: 3, 1, 2,
Followers: 3, 1,
Cmd> TIMELINE
Command completed successfully
Now you are in the timeline
1 (Fri Nov 24 20:06:33 2023) >> p12
1 (Fri Nov 24 20:06:32 2023) >> p11
p21
p22
3 (Fri Nov 24 20:09:53 2023) >> p31
3 (Fri Nov 24 20:09:54 2023) >> p32
^Z
[1]+  Stopped                 ./tsc -h localhost -k 9000 -u 2
csce662@csce662:~/MP2.2$ ./tsc -h localhost -k 9000 -u 2

========= TINY SNS CLIENT =========
 Command Lists and Format:
 FOLLOW <username>
 UNFOLLOW <username>
 LIST
 TIMELINE
===================================
Cmd> FOLLOW 5
Command completed successfully
Cmd> LIST
Command completed successfully
All users: 3, 1, 2, 5,
Followers: 3, 1, 5,
Cmd> TIMELINE
Command completed successfully
Now you are in the timeline
3 (Fri Nov 24 20:22:55 2023) >> p34
3 (Fri Nov 24 20:22:54 2023) >> p33
5 (Fri Nov 24 20:21:29 2023) >> p52
5 (Fri Nov 24 20:21:27 2023) >> p51
3 (Fri Nov 24 20:09:54 2023) >> p32
3 (Fri Nov 24 20:09:53 2023) >> p31
1 (Fri Nov 24 20:06:33 2023) >> p12
1 (Fri Nov 24 20:06:32 2023) >> p11
p23
p24
1 (Fri Nov 24 20:25:00 2023) >> p13
1 (Fri Nov 24 20:25:02 2023) >> p14
5 (Fri Nov 24 20:28:18 2023) >> p53
5 (Fri Nov 24 20:28:20 2023) >> p54
```

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Client 3

```
csce662@csce662:~/MP2.2$ ./tsc -h localhost -k 9000 -u 3

========= TINY SNS CLIENT =========
 Command Lists and Format:
 FOLLOW <username>
 UNFOLLOW <username>
 LIST
 TIMELINE
===================================
Cmd> LIST
Command completed successfully
All users: 1, 2, 3,
Followers:
Cmd> FOLLOW 1
Command completed successfully
Cmd> FOLLOW 2
Command completed successfully
Cmd> LIST
Command completed successfully
All users: 1, 2, 3,
Followers: 1, 2,
Cmd> TIMELINE
Command completed successfully
Now you are in the timeline
2 (Fri Nov 24 20:08:36 2023) >> p22
2 (Fri Nov 24 20:08:35 2023) >> p21
1 (Fri Nov 24 20:06:33 2023) >> p12
1 (Fri Nov 24 20:06:32 2023) >> p11
p31
p32
^Z
[1]+  Stopped                 ./tsc -h localhost -k 9000 -u 3
csce662@csce662:~/MP2.2$ ./tsc -h localhost -k 9000 -u 3

========= TINY SNS CLIENT =========
 Command Lists and Format:
 FOLLOW <username>
 UNFOLLOW <username>
 LIST
 TIMELINE
===================================
Cmd> FOLLOW 5
Command completed successfully
Cmd> LIST
Command completed successfully
All users: 5, 1, 2, 3,
Followers: 5, 1, 2,
Cmd> TIMELINE
Command completed successfully
Now you are in the timeline
5 (Fri Nov 24 20:21:29 2023) >> p52
5 (Fri Nov 24 20:21:27 2023) >> p51
2 (Fri Nov 24 20:08:36 2023) >> p22
2 (Fri Nov 24 20:08:35 2023) >> p21
1 (Fri Nov 24 20:06:33 2023) >> p12
1 (Fri Nov 24 20:06:32 2023) >> p11
p33
p34
2 (Fri Nov 24 20:24:06 2023) >> p23
2 (Fri Nov 24 20:24:08 2023) >> p24
1 (Fri Nov 24 20:25:00 2023) >> p13
1 (Fri Nov 24 20:25:02 2023) >> p14
5 (Fri Nov 24 20:28:18 2023) >> p53
5 (Fri Nov 24 20:28:20 2023) >> p54
```

Client 5

```
csce662@csce662:~/MP2.2$ ./tsc -h localhost -k 9000 -u 5

========= TINY SNS CLIENT =========
 Command Lists and Format:
 FOLLOW <username>
 UNFOLLOW <username>
 LIST
 TIMELINE
===================================
Cmd> LIST
Command completed successfully
All users: 3, 1, 2, 5,
Followers:
Cmd> FOLLOW 1
Command completed successfully
Cmd> FOLLOW 2
Command completed successfully
Cmd> FOLLOW
Invalid Command
Cmd> FOLLOW 3
Command completed successfully
Cmd> LIST
Command completed successfully
All users: 3, 1, 2, 5,
Followers: 1, 3, 2,
Cmd> TIMELINE
Command completed successfully
Now you are in the timeline
p51
p52
3 (Fri Nov 24 20:22:54 2023) >> p33
3 (Fri Nov 24 20:22:55 2023) >> p34
2 (Fri Nov 24 20:24:06 2023) >> p23
2 (Fri Nov 24 20:24:08 2023) >> p24
1 (Fri Nov 24 20:25:00 2023) >> p13
1 (Fri Nov 24 20:25:02 2023) >> p14
^Z
[1]+  Stopped                 ./tsc -h localhost -k 9000 -u 5
csce662@csce662:~/MP2.2$ ./tsc -h localhost -k 9000 -u 5

========= TINY SNS CLIENT =========
 Command Lists and Format:
 FOLLOW <username>
 UNFOLLOW <username>
 LIST
 TIMELINE
===================================
Cmd> LIST
Command completed successfully
All users: 3, 1, 2, 5,
Followers: 1, 3, 2,
Cmd> TIMELINE
Command completed successfully
Now you are in the timeline
1 (Fri Nov 24 20:25:02 2023) >> p14
1 (Fri Nov 24 20:25:00 2023) >> p13
2 (Fri Nov 24 20:24:08 2023) >> p24
2 (Fri Nov 24 20:24:06 2023) >> p23
3 (Fri Nov 24 20:22:55 2023) >> p34
3 (Fri Nov 24 20:22:54 2023) >> p33
p53
p54
```