Report

1.Testcase Generator

The configuration for generating test cases is fetched from the file config_parameter.json

1.1 Testcase Generator Parameters

1. nreplicas(integer): No. of validators (excluding twins)
2. ntwins(integer): No. of twins
3. npartitions(integer): No. of partitions
4. nrounds(integer): No. of rounds
5. deterministic(boolean): Whether the testcase scenarios should be generated randomly or deterministically
6. onlyFaultyLeaders(boolean): Whether only faulty leaders can become leaders or not
7. maxpartitionsConfigs(integer): No. of distinct partition scenarios that should be used after Step 1 of test generator. This parameter is provided to support enumeration limits.
8. onlyProgressivePartitionConfigs(boolean): If true, then only partitions having super majority quorums are considered and leaders are elected in such a way that at least some command gets committed in a ledger of replicas with high probability.
9. message_types_to_drop(list of strings): Type of messages that can be dropped within a partition.
10. message_type_drop_probability(integer between 0 and 1): probability with which an intra-partition message loss (vote msg or proposal msg) can be introduced with a particular round
11. timeout_msg_drop_cnt(integer): To support dropping of timeout messages this parameter has been introduced. This parameter is the no. of timeout messages that the network playground should drop.

Note: When onlyProgressiveConfigs = True, parameters options such as onlyFaultyLeaders, message_types_to_drop and message_type_drop_probability are ignored.

1.2 Running Time

Average Time Taken to generate a test case scenario: 0.23 milliseconds

1.3 Instructions

Use the following command to run the test generator:

python testcase_generator.py “output.json”

This command will write a testcase to the file “output.json”.

1.4 Sample Test Cases Generated

Configuration 1:

nreplicas=4, ntwins=1, npartitions=2, nrounds=7, deterministic=False, onlyfaultyleaders=False, maxpartitionsConfigs=100, onlyProgressivePartitionConfigs=False, message_types_to_drop=[], message_type_drop_probability=0, timeout_msg_drop_cnt=0

Output 1:


```
{"round_configs":

  {

        "1": {"leader": ["B"], "partitions": [["A", "C", "D", "A'"], ["B"]]},

        "2": {"leader": ["B"], "partitions": [["A", "B", "A'"], ["C", "D"]]},

        "3": {"leader": ["C"], "partitions": [["A", "B", "C"], ["D", "A'"]]},

        "4": {"leader": ["C"], "partitions": [["A", "B", "C", "D"], ["A'"]]},

        "5": {"leader": ["B"], "partitions": [["A", "B", "C"], ["D", "A'"]]},
        "6": {"leader": ["A", "A'"], "partitions": [["A", "B", "C", "D"], ["A'"]]},
        "7": {"leader": ["D"], "partitions": [["A", "B", "D", "A'"], ["C"]]}

},

  "timeout_msg_drop_cnt": 0,

  "no_of_twins": 1,

  "no_of_rounds": 7,
```

"no_of_replicas": 4

}

Configuration 2:

nreplicas=4, ntwins=1, npartitions=2, nrounds=7, deterministic=False, onlyfaultyleaders=False, maxpartitionsConfigs=6, onlyProgressivePartitionConfigs=True,message_types_to_drop=[], message_type_drop_probability=0, timeout_msg_drop_cnt=0

Output 2:

{"round_configs":
{"1": {"leader": ["D"], "partitions": [["A", "C"], ["B", "D", "A'"]]}, "2": {"leader": ["D"], "partitions": [["A", "B"], ["C", "D", "A'"]]}, "3": {"leader": ["C"], "partitions": [["A", "B", "C", "A'"], ["D"]]}, "4": {"leader": ["B"], "partitions": [["A", "B", "C"], ["D", "A'"]]}, "5": {"leader": ["A", "A'"], "partitions": [["A", "C", "D", "A'"], ["B"]]}, "6": {"leader": ["A", "A'"], "partitions": [["A", "C", "D"], ["B", "A'"]]}, "7": {"leader": ["D"], "partitions": [["A", "C"], ["B", "D", "A'"]]}},

"timeout_msg_drop_cnt": 0,

"no_of_twins": 1,

"no_of_rounds": 7,

"no_of_replicas": 4

}

Configuration 3:

nreplicas=4, ntwins=1, npartitions=2, nrounds=7, deterministic=False, onlyfaultyleaders=True, maxpartitionsConfigs=6, onlyProgressivePartitionConfigs=False,message_types_to_drop=["Proposal", "Vote"], message_type_drop_probability=0.7, timeout_msg_drop_cnt=3

Output 3:

{"round_configs":

{"1": {"MsgType": "Proposal", "leader": ["A", "A'"], "partitions": [["A", "A'"], ["B", "C", "D"]]},

"2": {"MsgType": "Vote", "leader": ["A", "A'"], "partitions": [["A", "C"], ["B", "D", "A'"]]},

"3": {"MsgType": "Vote", "leader": ["A", "A'"], "partitions": [["A", "C"], ["B", "D", "A'"]]},

"4": {"MsgType": "Vote", "leader": ["A", "A'"], "partitions": [["A", "D", "A'"], ["B", "C"]]},

"5": {"MsgType": "Proposal", "leader": ["A", "A'"], "partitions": [["A", "B", "C", "D"], ["A'"]]},

"6": {"leader": ["A", "A'"], "partitions": [["A", "C", "D", "A'"], ["B"]]},

"7": {"MsgType": "Vote", "leader": ["A", "A'"], "partitions": [["A", "C", "A'"], ["B", "D"]]}},

"timeout_msg_drop_cnt": 3,

"no_of_twins": 1, "no_of_rounds": 7, "no_of_replicas": 4}

2. Scenario Executor Tests

Testcase 0

```
{"round_configs":
    {
    "1": {"leader": ["A", "A'"], "partitions": [["A", "B", "C", "D"], ["A'"]]},
    "2": {"leader": ["A", "A'"], "partitions": [["A", "B", "C", "A'","D"]]},
    "3": {"leader": ["A", "A'"], "partitions": [["A", "B", "D", "A'", "C"]]},
    "4": {"leader": ["A", "A'"], "partitions": [["A", "B", "D"], ["C", "A'"]]},
    "5": {"leader": ["B"], "partitions": [["A", "B", "C"], ["A'","D"]]},
    "6": {"leader": ["B"], "partitions": [["A", "B", "C"], ["A'","D"]]},
    "7": {"leader": ["B"], "partitions": [["A", "B", "C"], ["A'","D"]]}
    },
    "no_of_twins": 1, "no_of_rounds": 7, "no_of_replicas": 4,
"timeout_msg_drop_cnt" : 0
}
```


Output
Ledgers are consistent and 5 client requests are committed

Testcase 1

Bug Injected: 2*f + 1 → 2*f


```
{"round_configs":
    {
    "1": {"leader": ["A", "A'"], "partitions": [["A", "B", "C"], [ "A'","D"]]},
    "2": {"leader": ["A", "A'"], "partitions": [["A", "B", "C"], ["A'","D"]]},
    "3": {"leader": ["A", "A'"], "partitions": [["A", "B", "C"], ["A'","D"]]},
    "4": {"leader": ["A", "A'"], "partitions": [["A", "B", "D"], ["C", "A'"]]},
    "5": {"leader": ["B"], "partitions": [["A", "B", "C"], ["A'","D"]]},
    "6": {"leader": ["B"], "partitions": [["A", "B", "C"], ["A'","D"]]},
    "7": {"leader": ["B"], "partitions": [["A", "B", "C"], ["A'","D"]]}
    },
    "no_of_twins": 1, "no_of_rounds": 7, "no_of_replicas": 4,
"timeout_msg_drop_cnt" : 0
}
```


Output
Ledgers are inconsistent. Safety Violated after 2nd round

Testcase 2

```
{"round_configs":
    {
    "1": {"leader": ["A", "A'"], "partitions": [["A"],["B", "C"], [ "A'","D"]]},
    "2": {"leader": ["A", "A'"], "partitions": [["A"],["B", "C"], ["A'","D"]]},
    "3": {"leader": ["A", "A'"], "partitions": [["A"],["B", "C"], ["A'","D"]]},
    "4": {"leader": ["A", "A'"], "partitions": [["A"], ["B", "D"], ["C", "A'"]]},
    "5": {"leader": ["B"], "partitions": [["A", "B", "C"], ["A'","D"]]},
    "6": {"leader": ["B"], "partitions": [["A", "B", "C"], ["A'","D"]]},
    "7": {"leader": ["B"], "partitions": [["A", "B", "C"], ["A'","D"]]}
    },
    "no_of_twins": 1, "no_of_rounds": 7, "no_of_replicas": 4,
"timeout_msg_drop_cnt" : 0
}
```


Output
Liveness violated after liveness_timeout time

Testcase 3


```
{"round_configs":
    {
    "1": {"leader": ["A", "A'"], "partitions": [["A", "B", "C", "D"], ["A'"]]},
    "2": {"leader": ["A", "A'"], "partitions": [["A", "B", "C", "A'","D"]]},
    "3": {"leader": ["A", "A'"], "partitions": [["A", "B", "D", "A'", "C"]]},
    "4": {"leader": ["A", "A'"], "partitions": [["A", "B", "D"], ["C", "A'"]]},
    "5": {"leader": ["B"], "partitions": [["A", "B", "C"], ["A'","D"]]},
    "6": {"leader": ["B"], "partitions": [["A", "B", "C"], ["A'","D"]]},
    "7": {"leader": ["B"], "partitions": [["A", "B", "C"], ["A'","D"]]}
    },
    "no_of_twins": 1, "no_of_rounds": 7, "no_of_replicas": 4,
"timeout_msg_drop_cnt" : 4
}
```

Output
Possible Bug : Each replica only sends a timeout message once, during the timeout. Hence, if timeout messages from all the replicas are dropped for the first time, the system fails to make a progress and Liveness is violated.
Liveness Timeout = 7 * delta

Solution: Restart the timer for current round after broadcasting TimeoutMsg

Testcase 4

```
{"round_configs":
    {
    "1": {"leader": ["A", "A'"], "partitions": [["A", "B", "C", "D"], ["A'"]],
"MsgType" : "Proposal"},
    "2": {"leader": ["A", "A'"], "partitions": [["A", "B", "C", "A'","D"]]},
    "3": {"leader": ["A", "A'"], "partitions": [["A", "B", "D", "A'", "C"]]},
    "4": {"leader": ["A", "A'"], "partitions": [["A", "B", "D"], ["C", "A'"]]},
    "5": {"leader": ["B"], "partitions": [["A", "B", "C"], ["A'","D"]]},
    "6": {"leader": ["B"], "partitions": [["A", "B", "C"], ["A'","D"]]},
    "7": {"leader": ["B"], "partitions": [["A", "B", "C"], ["A'","D"]]}
    },
    "no_of_twins": 1, "no_of_rounds": 7, "no_of_replicas": 4,
"timeout_msg_drop_cnt" : 0,
}
```

Output
Ledgers are consistent. First Proposal Msg is dropped → Timeout occurs → Timeout Certificate is formed → Client Requests are committed after round 1

Testcase 5
Bug Injected: Can vote for multiple proposals. Change safe_to_vote condition, do not consider highest_voted_round while sending vote_msg.

```
{"round_configs":
    {
 "1": {"leader": ["A"], "partitions": [["A", "B", "A'", "C", "D"]]},
 "2": {"leader": ["B"], "partitions": [["A", "B", "C", "D", "A'"]]},
```

```
"3": {"leader": ["C"], "partitions": [["A", "B", "C", "D", "A'"]]},
"4": {"leader": ["B"], "partitions": [["A", "B", "C", "D", "A'"]]},
"5": {"leader": ["A"], "partitions": [["A", "B", "C", "D", "A'"]]},
"6": {"leader": ["D"], "partitions": [["A", "B", "D", "A'", "C"]]}
    },
   "timeout_msg_drop_cnt": 0,
   "no_of_twins": 1,
   "no_of_rounds": 6,
   "no_of_replicas": 4
 }
```


Output

Logs are consistent.