

# A CONTROL PLANE IN TIME AND SPACE

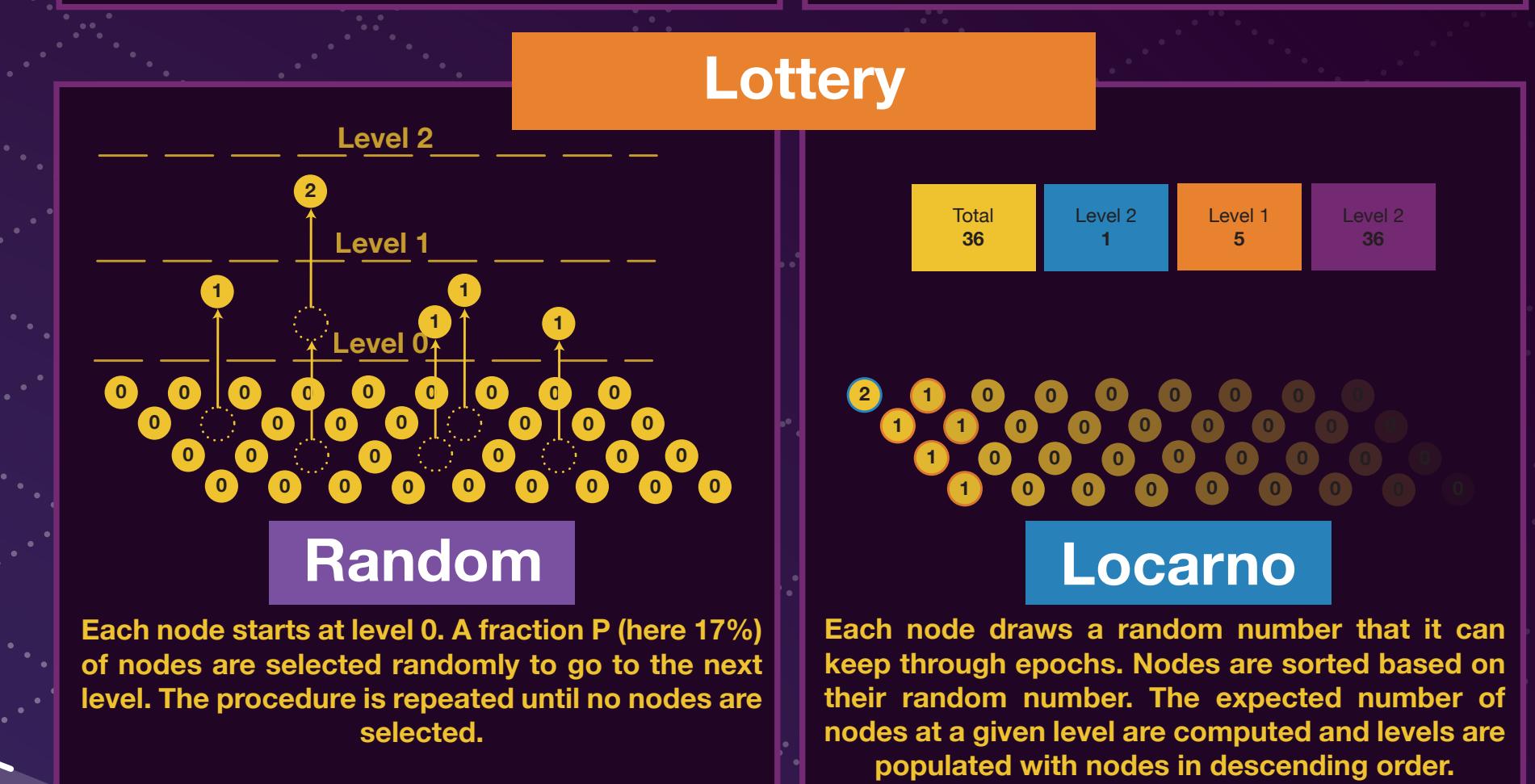
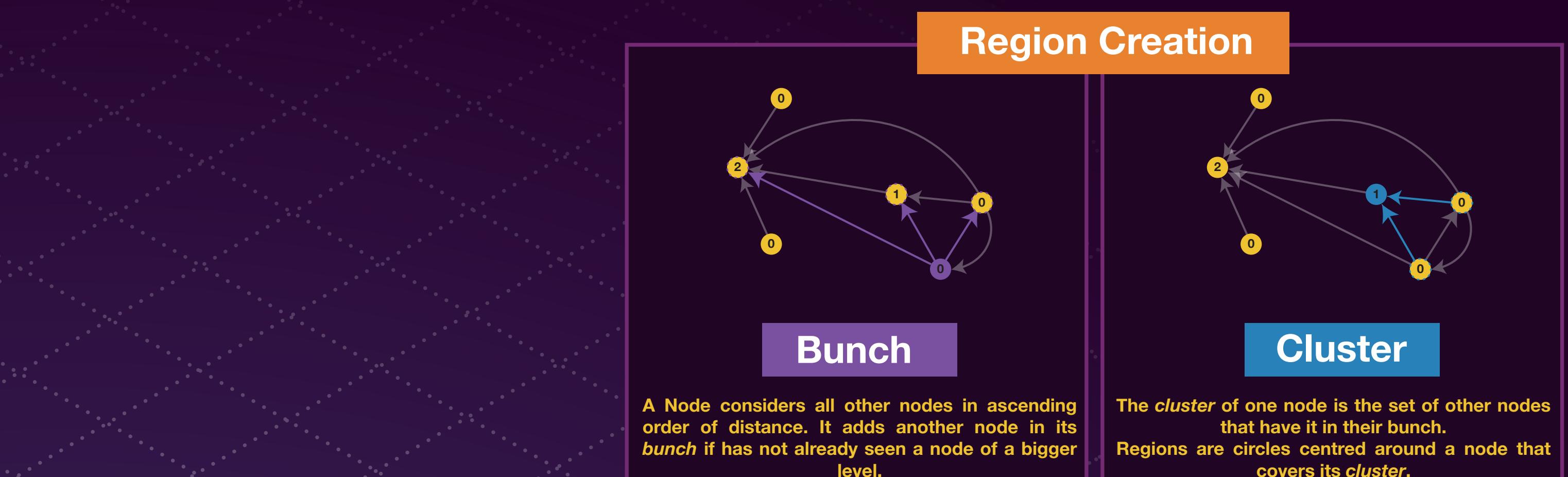
## FOR LOCALITY-PRESERVING BLOCKCHAINS

IF A GLOBAL PARTITION WERE TO HAPPEN IT COULD MEAN THE END OF MOST BLOCKCHAINS. GEOGRAPHICAL REPPLICATION ENSURES THAT ONE BLOCKCHAIN CONTINUES TO WORK IN REGIONS THAT ARE NOT SPLIT BY THE PARTITION. THIS WORK PROPOSES A PROTOCOL TO UPDATE REGIONS AS NODES JOIN, MOVE OR LEAVE THE SYSTEM.

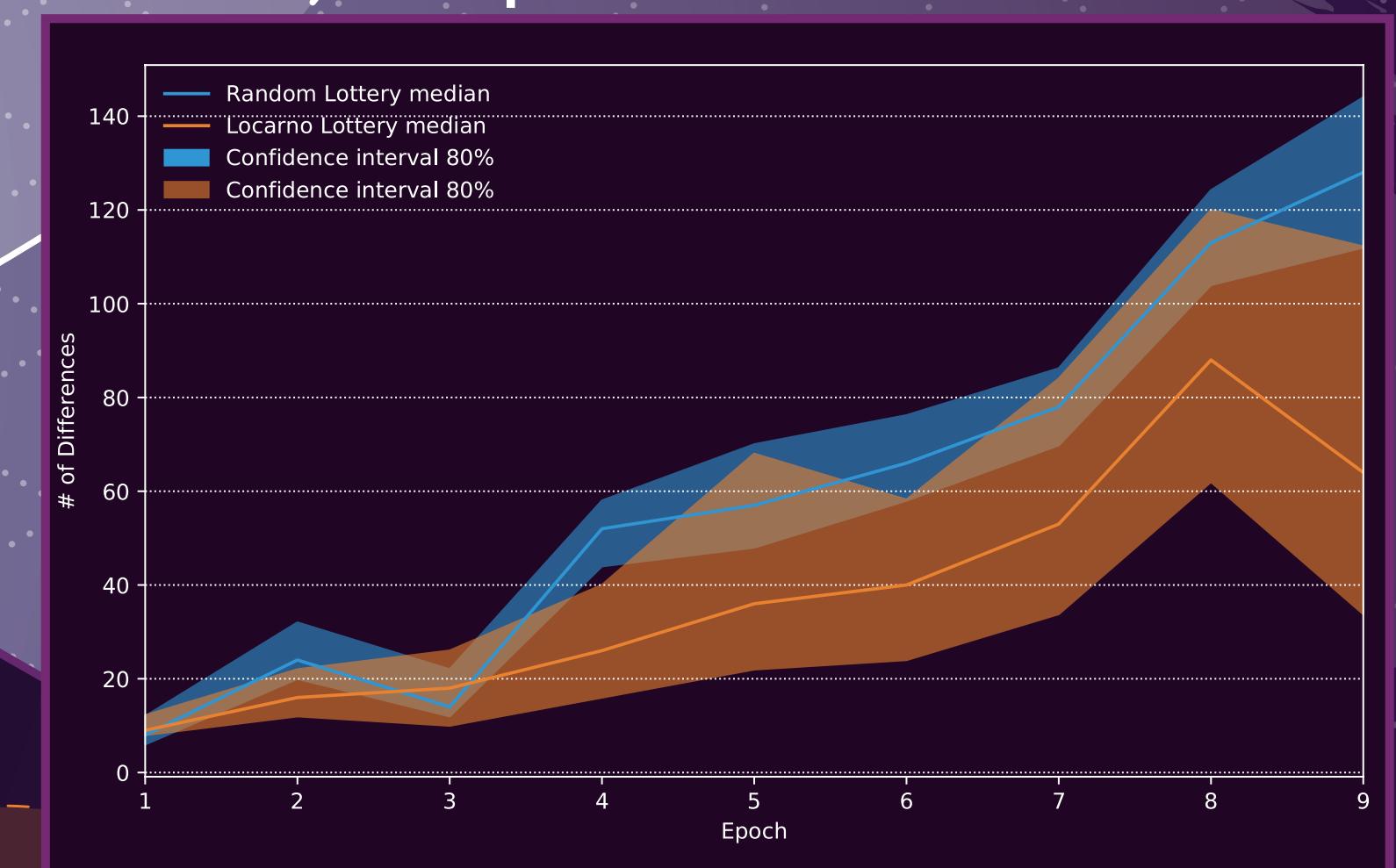
Nodes are the unit of the distributed system. Each one will draw a level from a lottery and compute their bunch and cluster. Then nodes create regions that cover their own cluster. Each region participates in regions that it created and that nodes in his cluster create. Distances are estimated using *Round Trip Time (RTT)*. It is guaranteed by design that any two nodes in the system participate within a region with a radius of a small multiple of their *RTT*.

- Region
- Region changing
- $i$  Node of level  $i$
- $A \rightarrow B$  A has level B in his bunch
- $i$  Node joining
- $i$  Node leaving
- $i$  Node moving

FIRST SOLUTION:  
NEXT EPOCH  
RANDOM LOTTERY



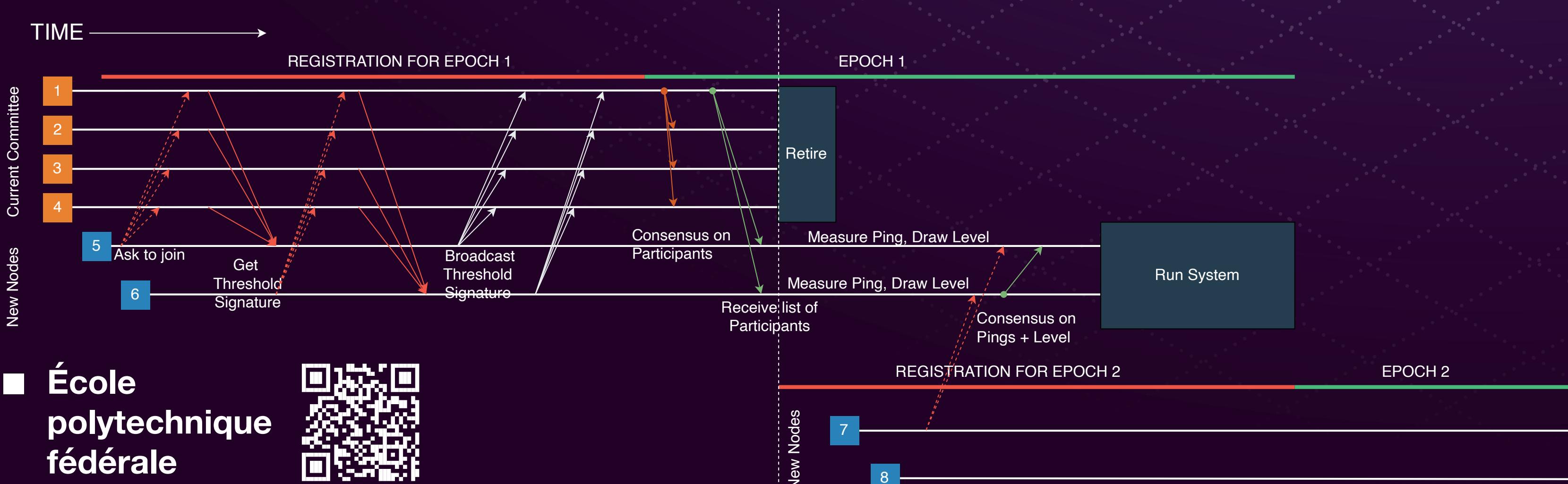
An improvement can be made on the lottery in order that more regions are left unchanged from one epoch to the next. Changing regions can lead to overhead due to data transmission. Allowing nodes to keep their level most of the time is the way to go. An experiment was made. The system starts with four nodes. Two additional nodes are added to the system at each epoch. 20% of nodes are allowed to move locally and 10% of nodes are allowed to teleport at another place in the system. The graph shows the results for both lottery and 100 experiments.



SECOND SOLUTION:  
NEXT EPOCH  
LOCARNO LOTTERY

TIME IS SPLIT INTO EPOCHS. AT THE BEGINNING OF EACH EPOCH, THE SYSTEM IS UPDATED AND THE REGIONS ARE REDRAWN. NODES IN THE SYSTEM AT A GIVEN EPOCH ARE THE AUTHORITY THAT CAN ACCEPT NODES FOR THE NEXT EPOCH AND RUN CONSENSUS. IT IS REQUIRED THAT IF THERE ARE  $N$  NODES IN THE SYSTEM THERE ARE LESS THAN  $f$  MALICIOUS NODES. WHERE  $f$  IS GIVEN BY  $3f + 1 = N$ . THE PROTOCOL DESCRIBED BELOW OFFERS A SOLUTION FOR THE UPDATE OF THE SYSTEM.

### CONTROL PLANE PROTOCOL



### CONTROL FLOW

