Adding High Availability to Condor Central Manager

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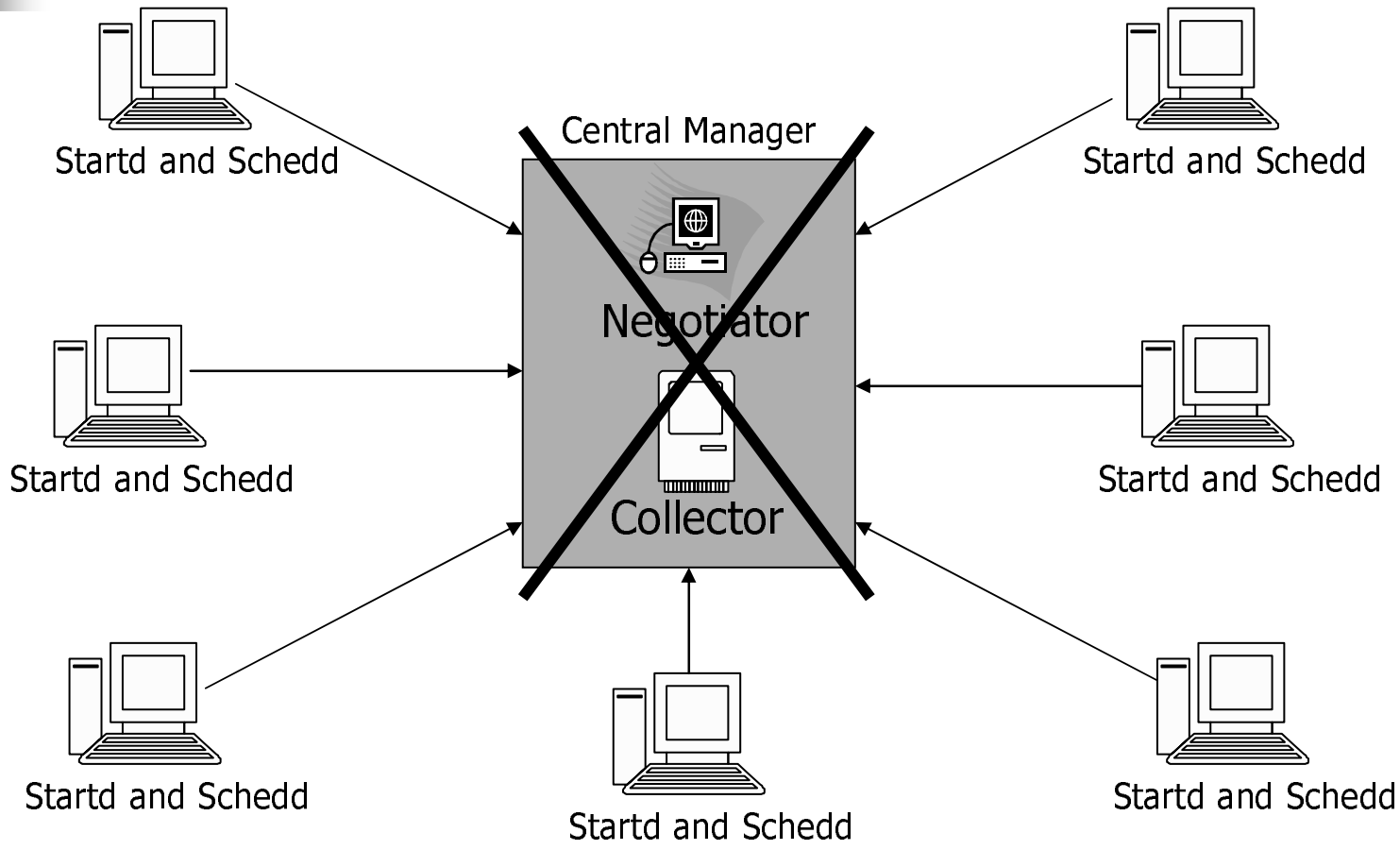
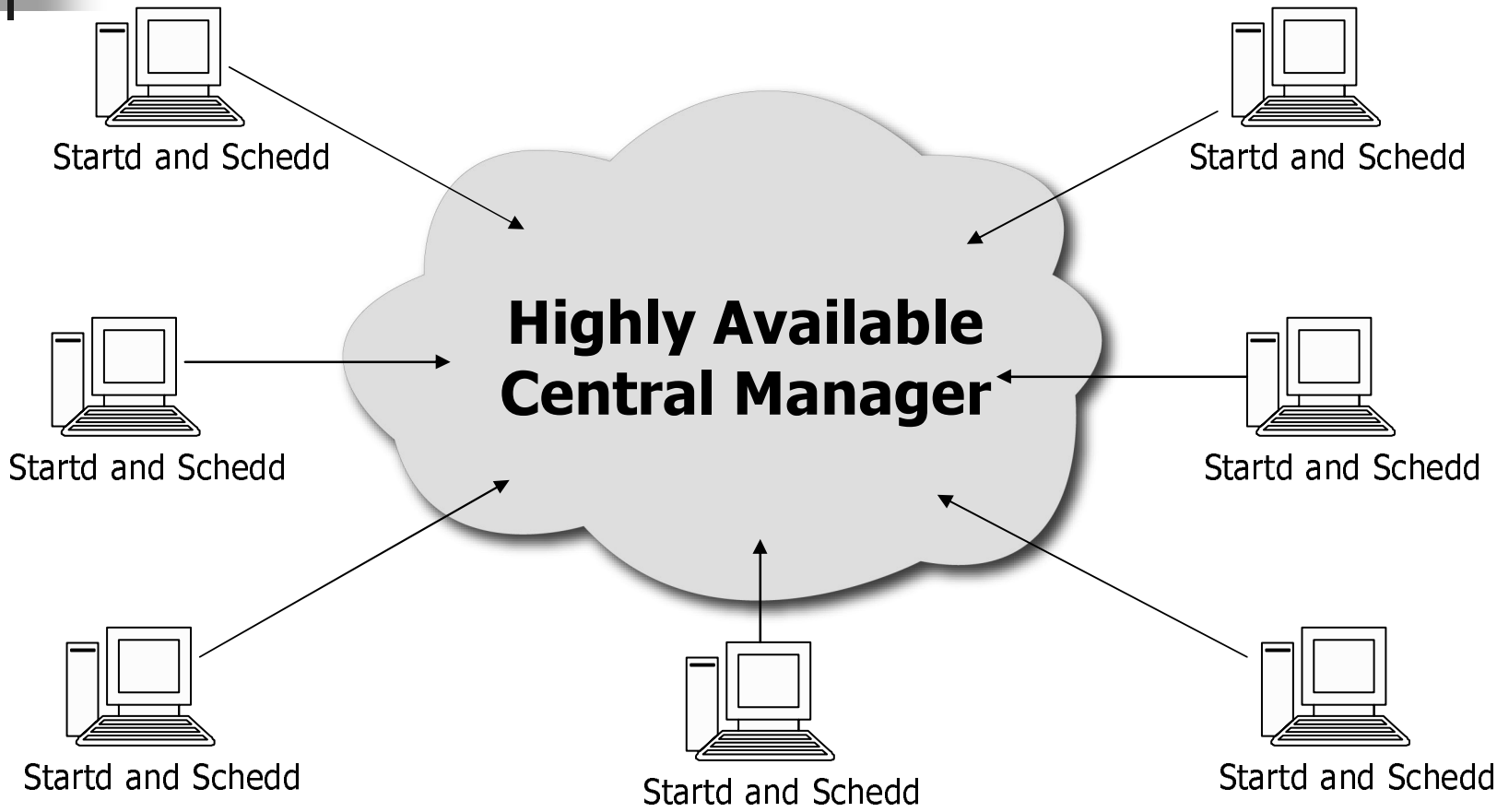
Condor Pool without High Availability



Why Highly Available CM?

- Central Manager is a **single-point-of-failure**
  - No additional matches are possible
  - Condor tools do not work
  - Unfair resource sharing and user priorities
- Our goal - **continuous pool functioning** in case of failure

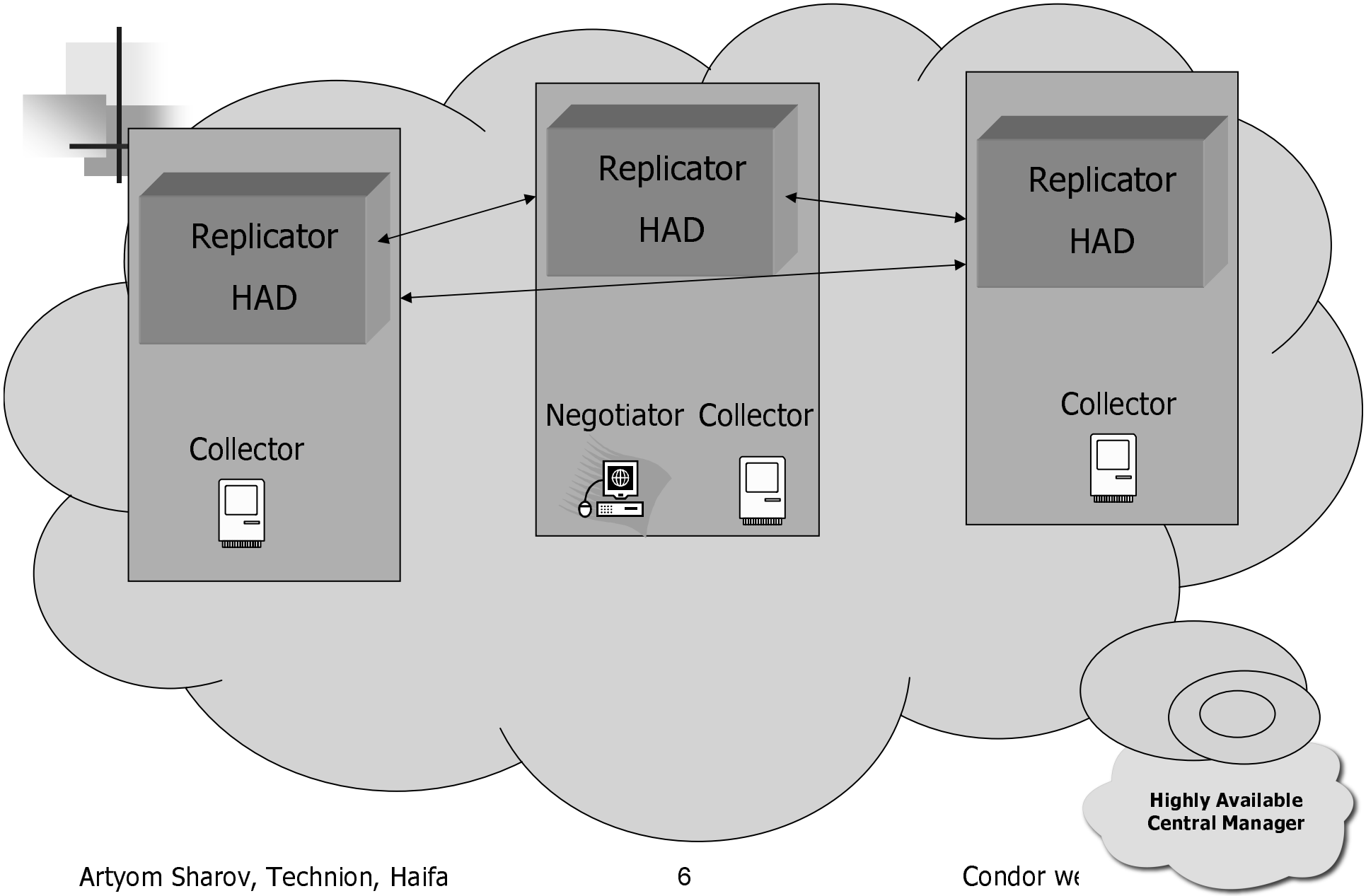
Highly Available Condor Pool



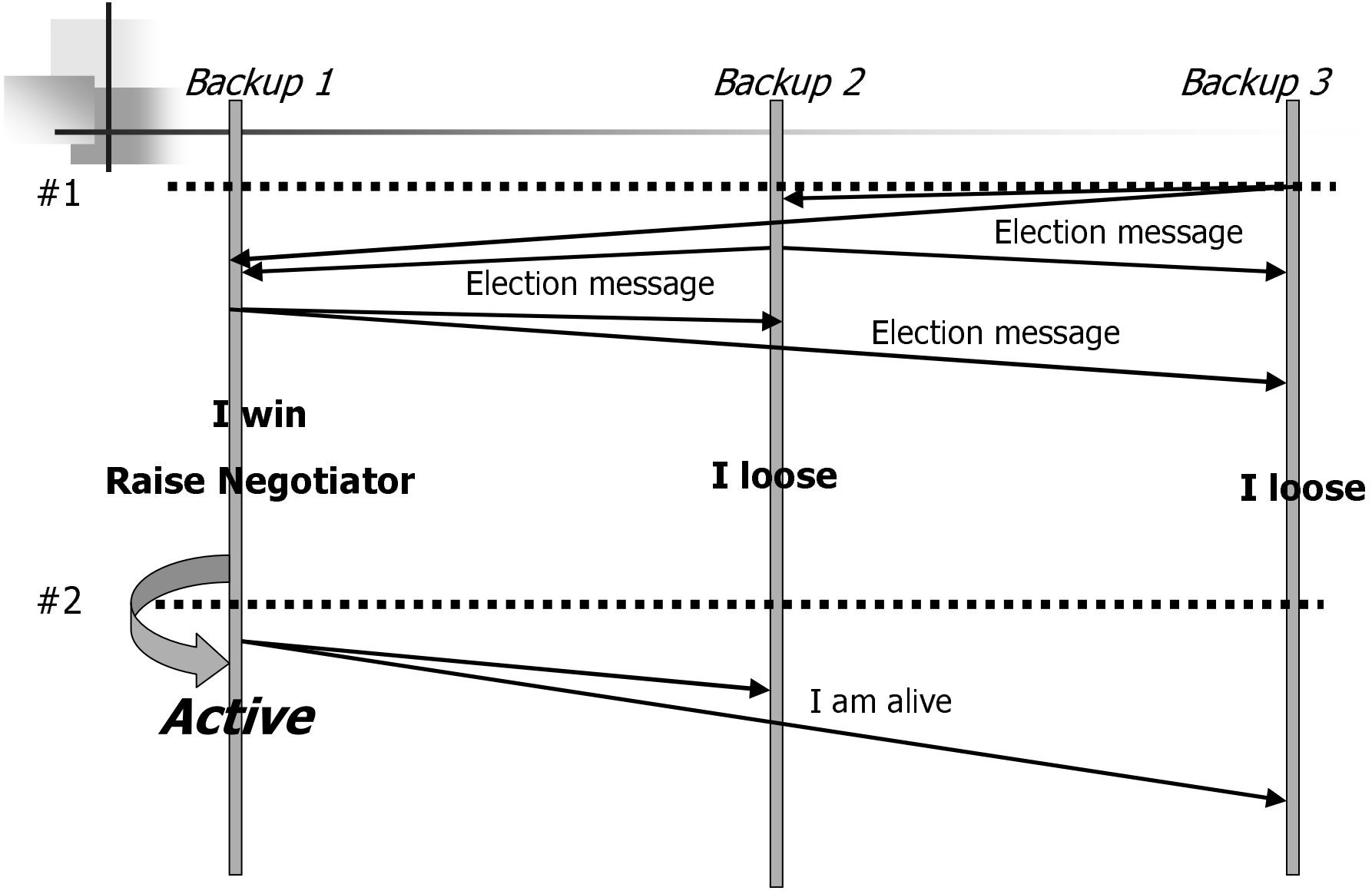
Solution Requirements

- Automatic failure detection
- Transparent failover
- “Split brain” reconciliation
- Persistency of CM state
- No changes to CM code

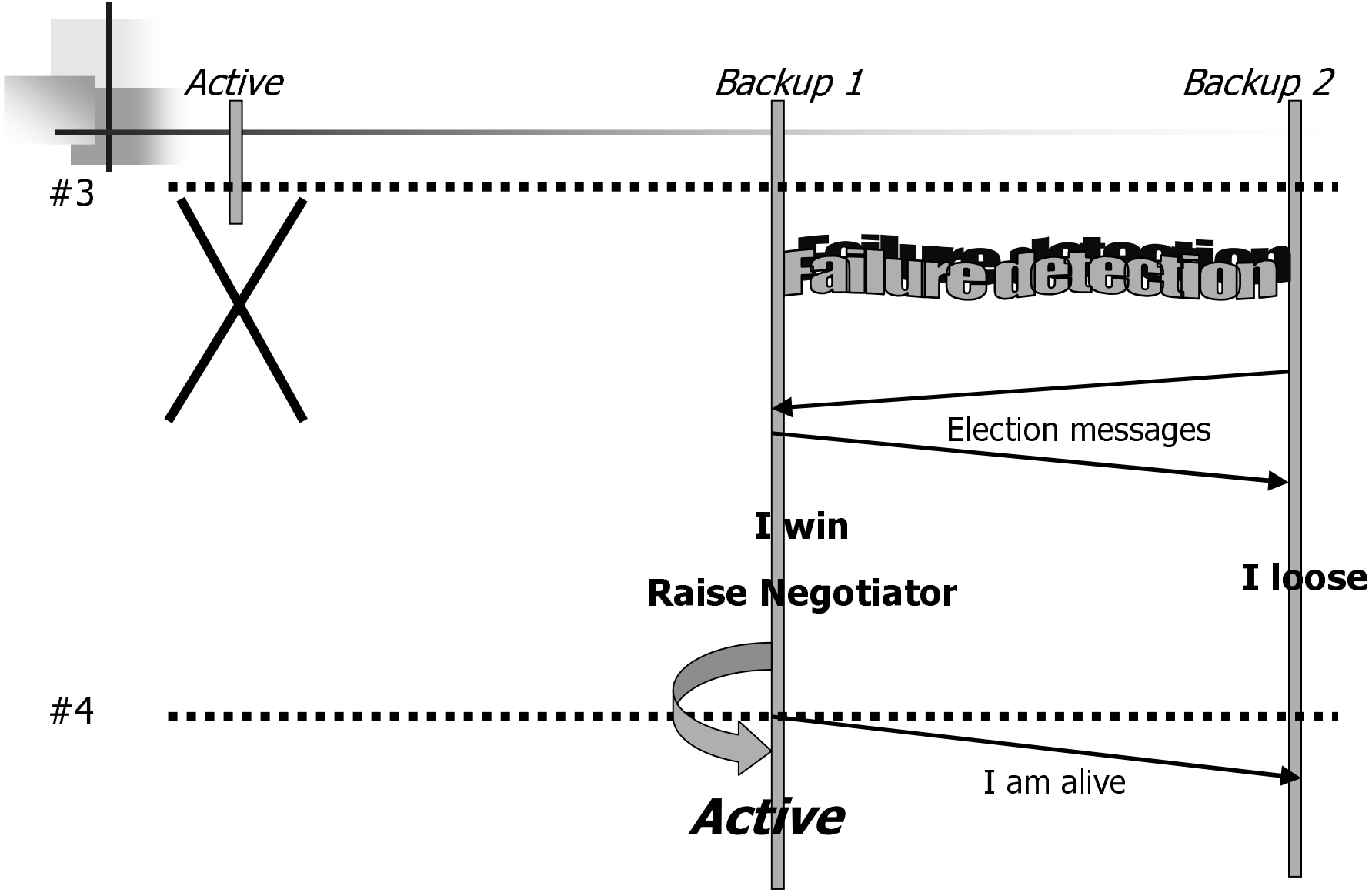
Condor Pool with HA



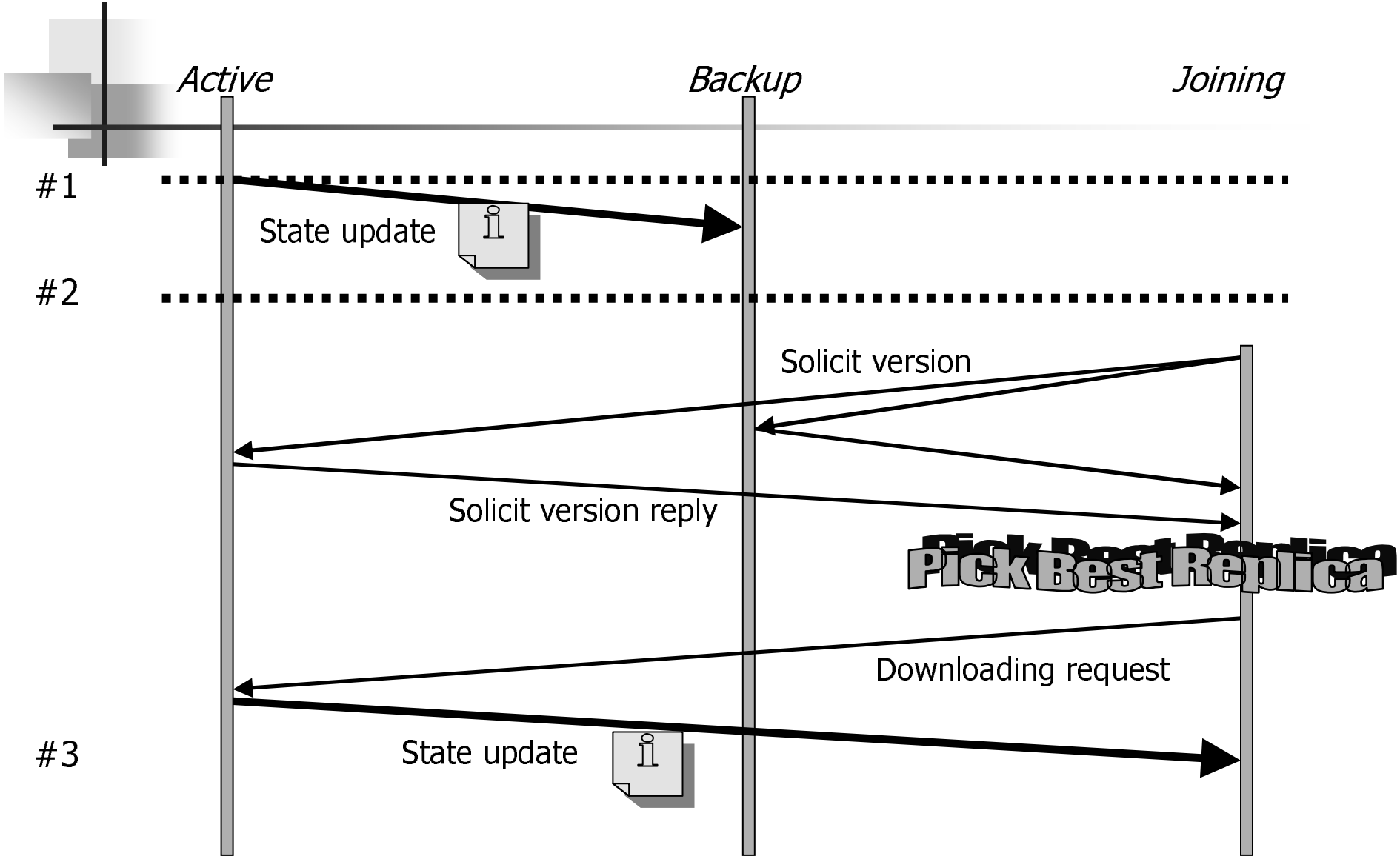
HA – Election + Main



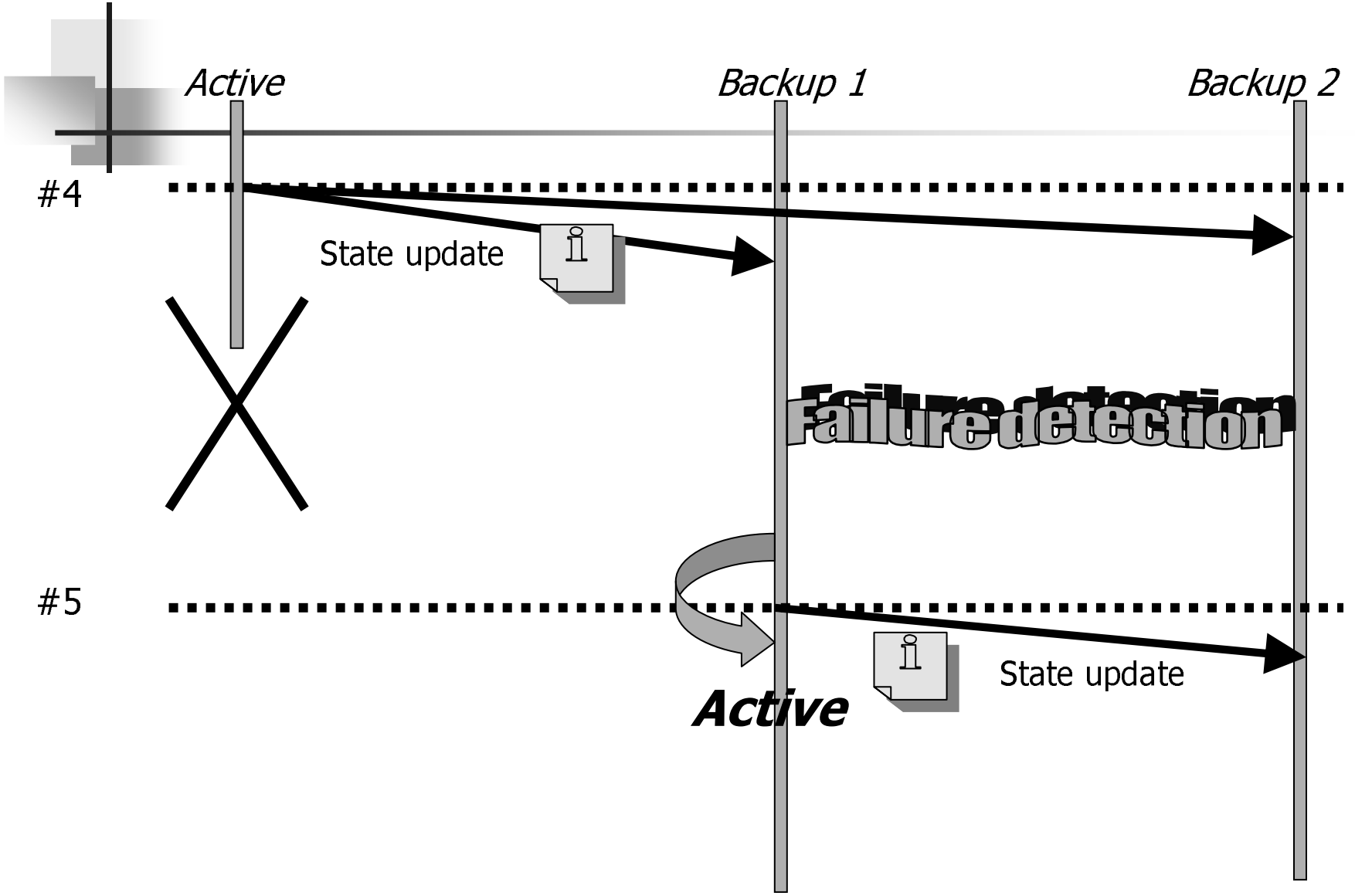
HA – Crash


Active
Backup 1
Backup 2
#3
Failure detection
Election messages
I win
Raise Negotiator
I loose
#4
I am alive
Active

Replication – Main + Joining



Replication – Crash



Configuration

- **Stabilization time**
  - Depends on number of CMs and network performance
  - HAD_CONNECT_TIMEOUT – upper bound on the time to establish TCP connection
  - Example: HAD_CONNECT_TIMEOUT = 2 and 2 CMs - new Negotiator is guaranteed to be up and running after **48** seconds
- **Replication frequency**
  - REPLICATION_INTERVAL

Testing

- **Automatic distributed testing framework:** simulation of node crashes, network disconnections, network partition and merges
- **Extensive testing**:
  - distributed testing on 5 machines in the Technion
  - interactive distributed testing in Wisconsin pool
  - automatic testing with NMI framework

HA in Production

- Already **deployed and fully functioning** for more than a year in
  - Technion
  - GLOW, UW
  - California Department of Water Resources, Delta Modeling Section, Sacramento, CA
  - Hartford Life
  - Cycle Computing
  - Additional commercial users

Usability and Administration

- HAD Monitoring System
- Configuration/administration utilities
- Detailed manual section
- Full support by Technion team

Future Work

- HA in WAN
- HAIFA – High Availability Is For Anyone
  - HA for any Condor service (e.g.: HA for schedd)
  - More consistency schemes and HA semantics
  - Dynamic registration of services requiring HA
  - Dynamic addition/removal of replicas
- More details in "Materializing Highly Available Grids" - hot topic paper, to appear in HPDC 2006.

Collaboration with Condor Team

- Ongoing collaboration for 3 years
- Compliance with Condor coding standards
- Peer-reviewed code
- Integration with NMI framework
- Automation of testing
- Open-minded attitude of Condor team to numerous requests and questions
- Unique experience of working with large peer-managed group of talented programmers

Collaboration with Condor Team

This work was a collaborative effort of:

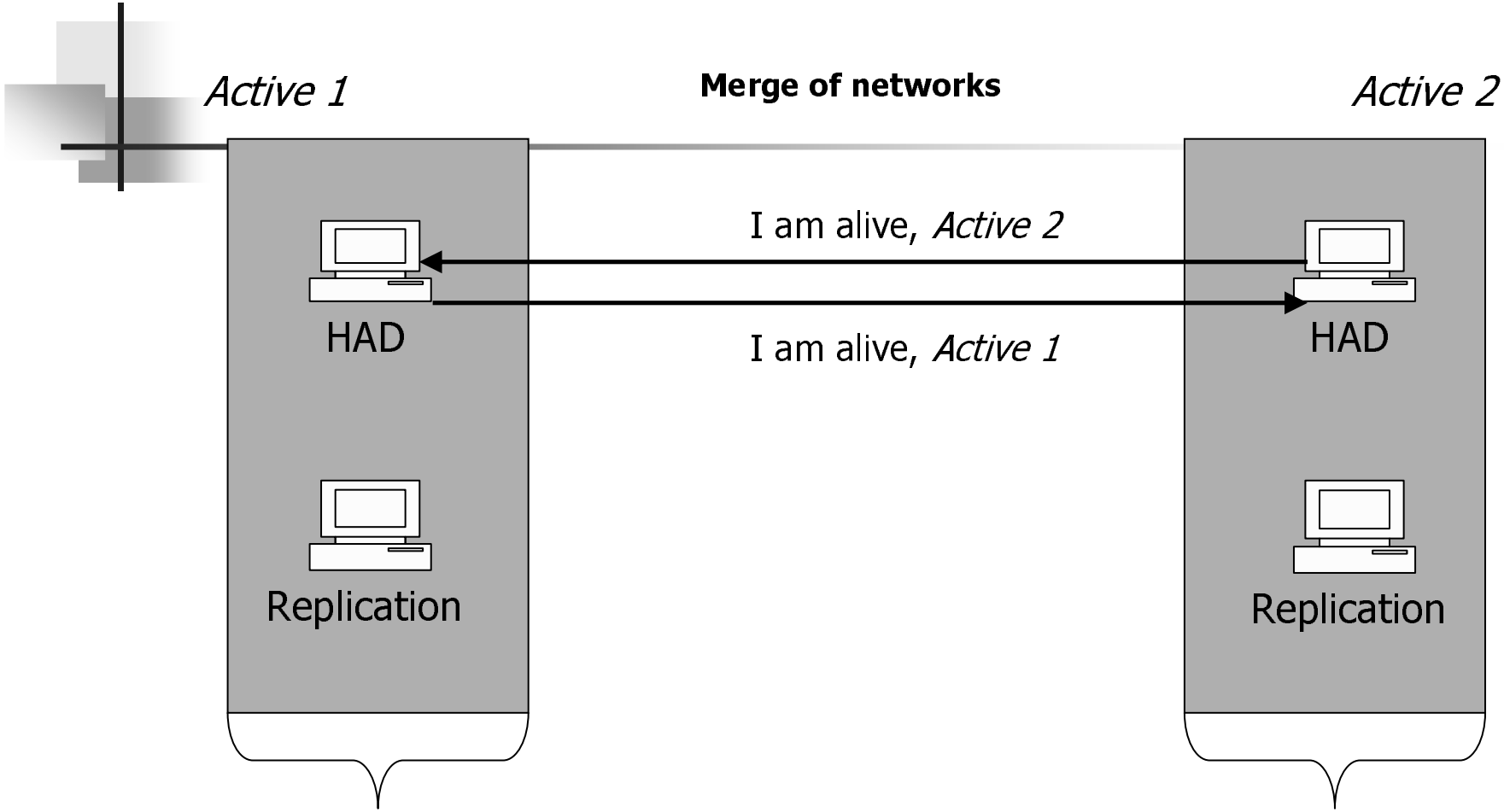
- **Distributed Systems Laboratory in Technion**
  - Prof. Assaf Schuster, Gabi Kliot, Mark Zilberstein, Artyom Sharov
- **Condor team**
  - Prof. Miron Livny, Nick, Todd, Derek, Greg, Anatoly, Peter, Becky, Bill, Tim

You Should Definitely Try It

- Part of the official 6.7.18 development release
- Will soon appear in stable 6.8 release
- More information:
  - http://dsl.cs.technion.ac.il/projects/gozal/project_pages/ha/ha.html
  - http://dsl.cs.technion.ac.il/projects/gozal/project_pages/replication/replication.html
  - more details + configuration in my tutorial
- Contact:
  - {gabik,marks,sharov}@cs.technion.ac.il
  - condor-users@cs.wisc.edu

In case of time

Replication – “Split Brain”



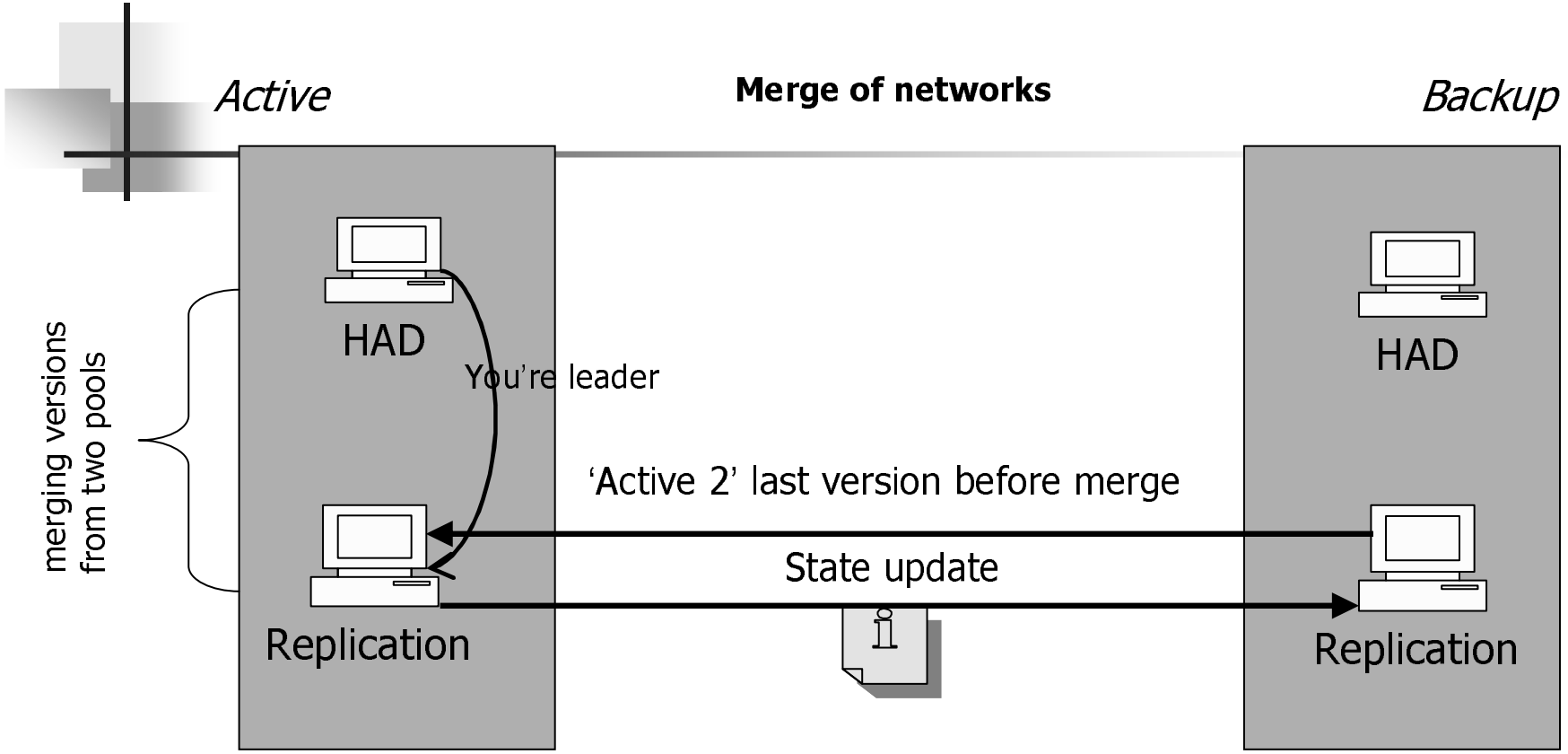
Decision making:

my ID > ‘Active 2’ ID, **I am a leader**

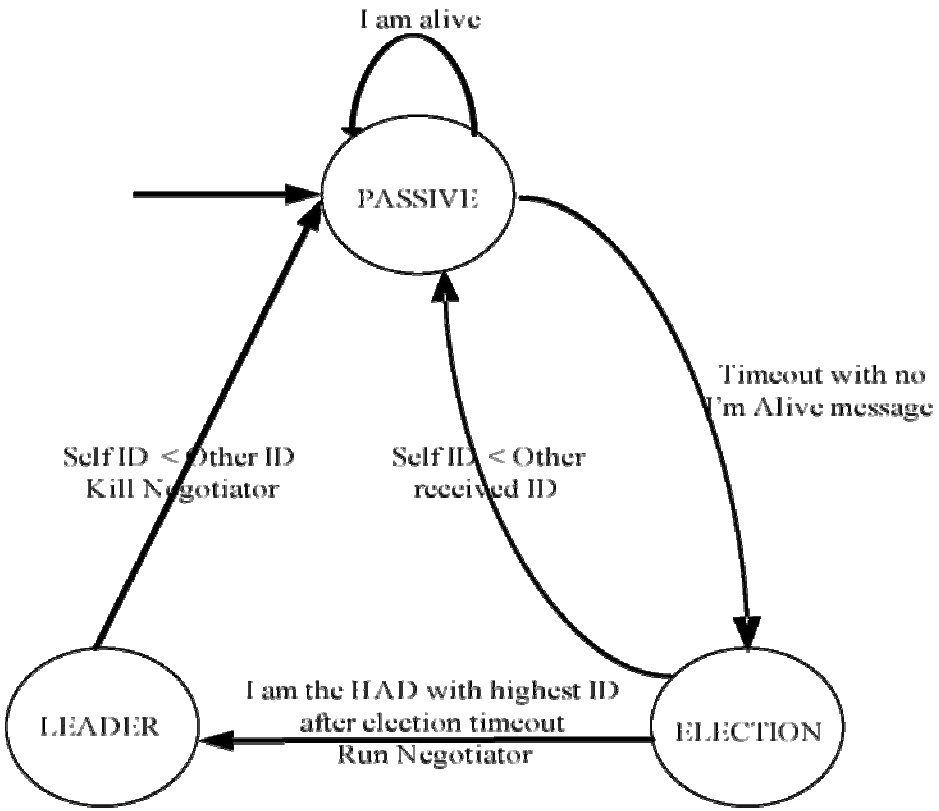
Decision making:

my ID < ‘Active 1’ ID, **give up**

Replication – “Split Brain”



HAD State Diagram



RD State Diagram