Leader Election in the Timed Finite Average Response Time Model

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Motivation
Denial of Service Attacks
Leader Election Problem

• **Liveness**
  Eventually there will be **one** leader forever.

• **Safety**
  At any point in time there is at most one leader.

• **Our Contribution**
  solve Leader Election without any synchrony
Finite Average Response Time Model

• no synchrony, no stability, however in balance

• average response time is finite
• congestion control
• no infinite speed of computation
Flow Control
Extreme Response Times

Async. System

FAR
◊P

- know how to solve ◊P
  ⇒ Consensus is solvable
- ◊P maintains a timeout
  - grows with small response times
  - shrinks with large response times
  - eventually timeout will be “perfect”
Leader Election in FAR

Run 1

\( p \quad \rightarrow \quad t \quad \rightarrow \quad q \)

\( s \)
Leader Election in FAR

Run 1

\[ \text{Run 2} \]

\[ \text{Run 2} \]

\[ \text{Run 2} \]

\[ \text{Run 2} \]
Timed FAR

- assume clocks with bounded drift rate $\rho$

$C_p(s) + \delta$

$s \rightarrow t$

$\delta = t - s$

$C_p(t)$

$C_p(s) + \delta$

$\rho(t - s)$

Real time

Clock time
Approach

• **Safety:** leases
  – each process supports at most one leadership at any point in time
  – leader must be supported by majority

• **Liveness:** ♦P
  – unsuspected process with smallest id
  – lease time bases on ♦P's timeout
Summary

• Leader Election solvable
  – NO synchrony
  – NO stable periods
• with reasonable asynchronous assumptions and clocks
• rely on internal timeout of ♦P

• complete algorithm is on poster