Distributed Systems

Terminating Reliable Broadcast

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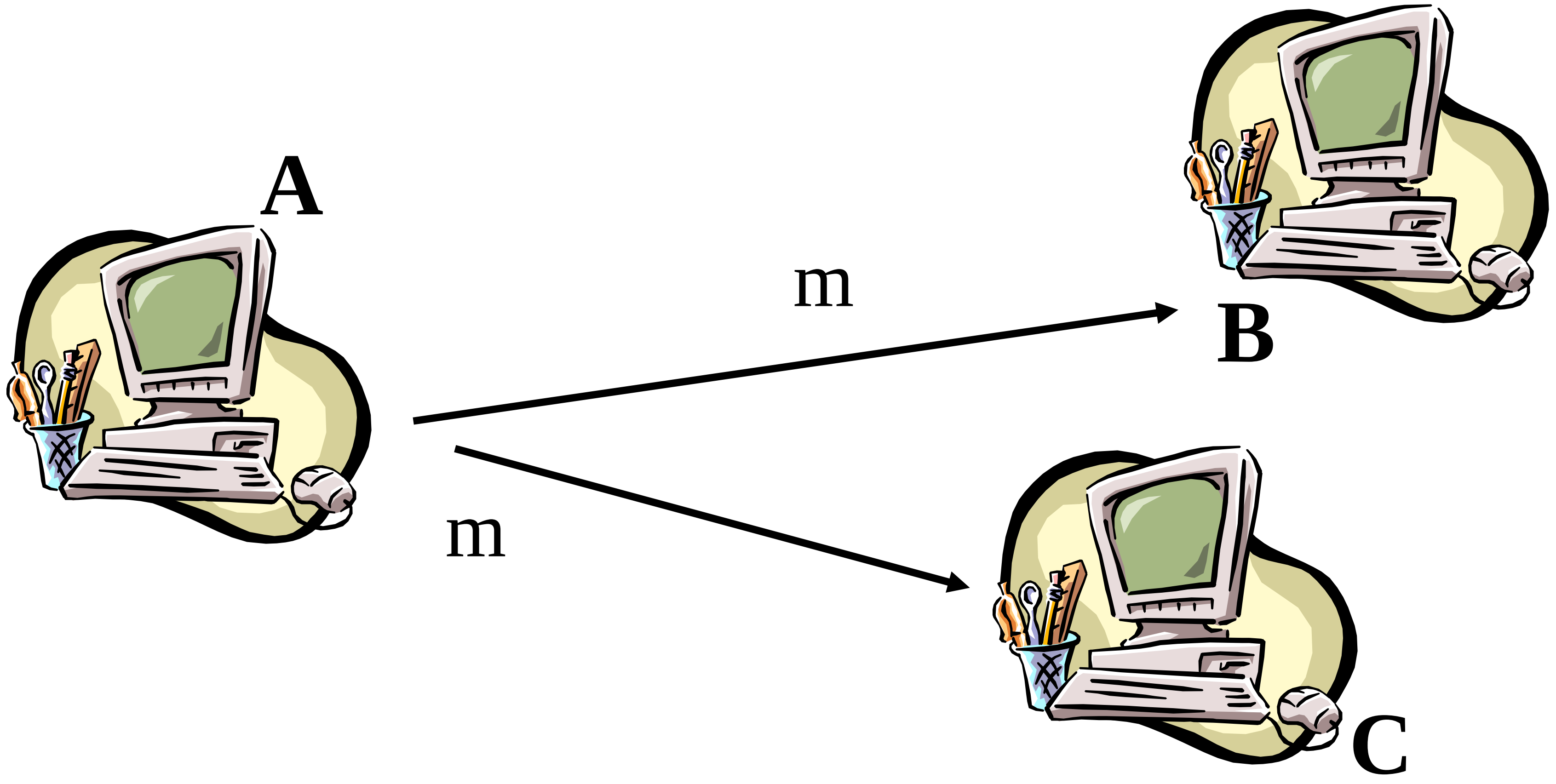
Terminating Reliable Broadcast

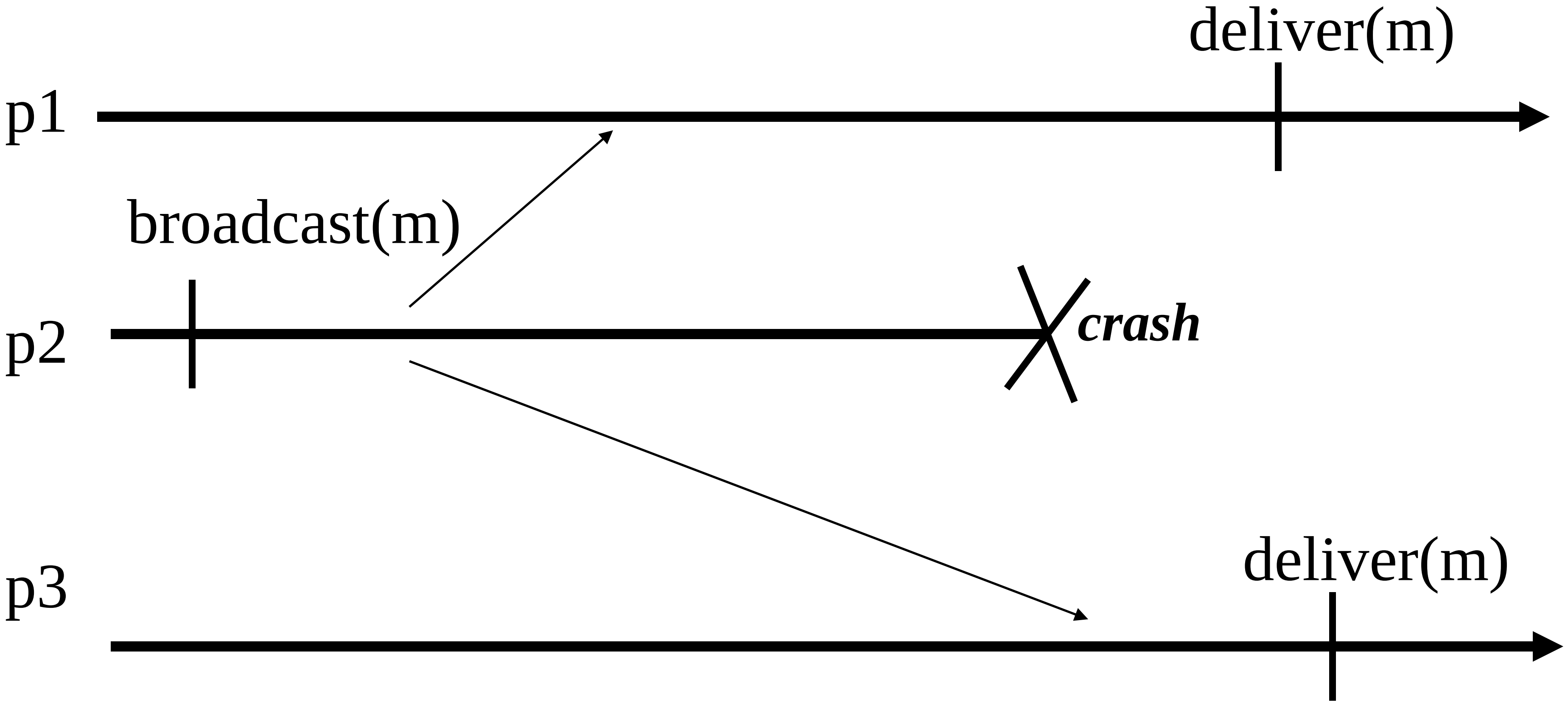


Terminating Reliable Broadcast

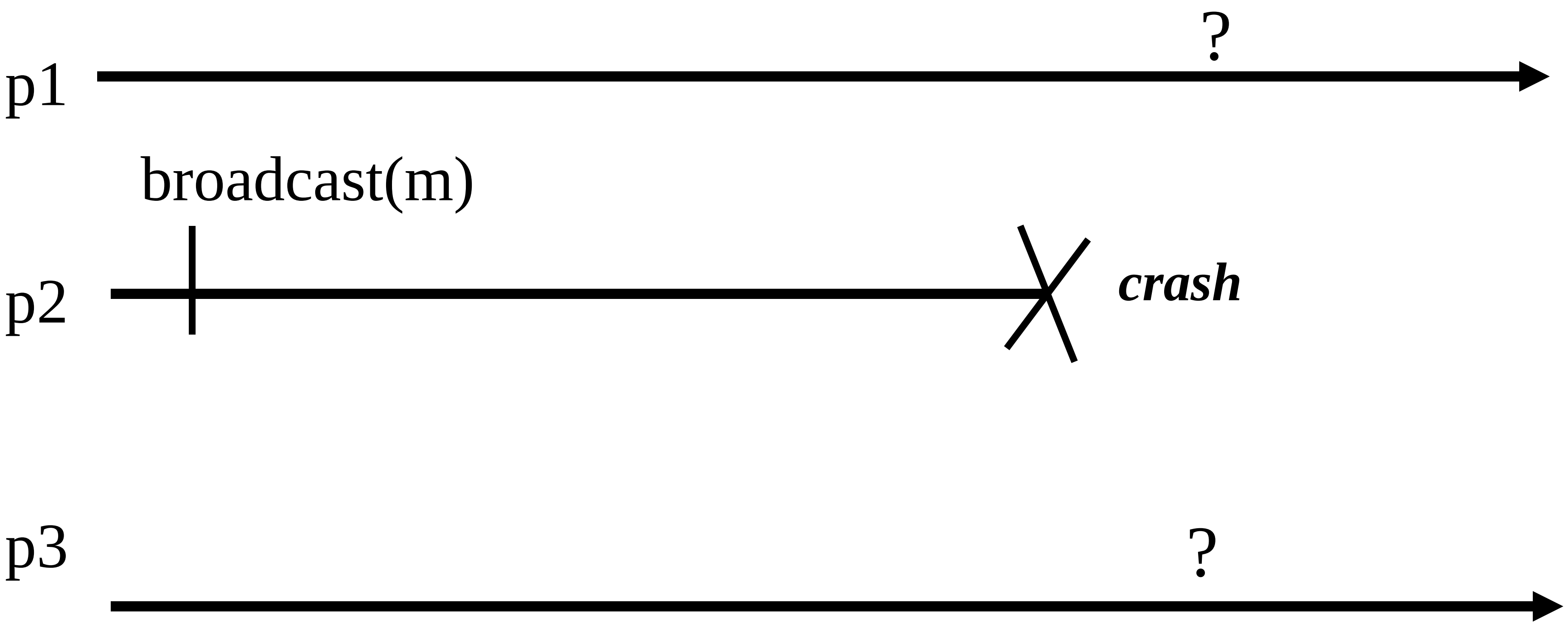
- Like reliable broadcast, terminating reliable broadcast (TRB) is a communication primitive used to disseminate a message among a set of processes in a reliable way

- TRB is however strictly stronger than (uniform) reliable broadcast

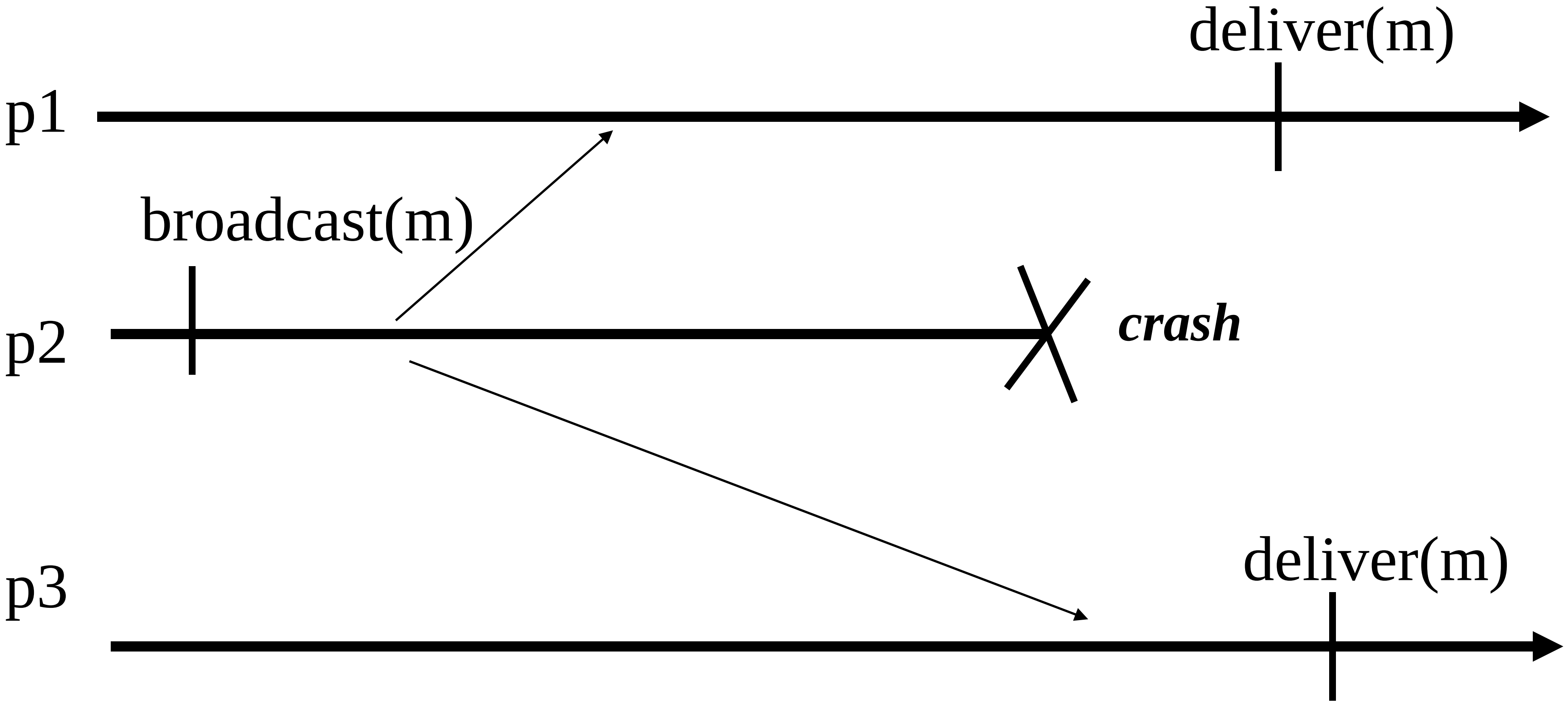
(Uniform) Reliable Broadcast



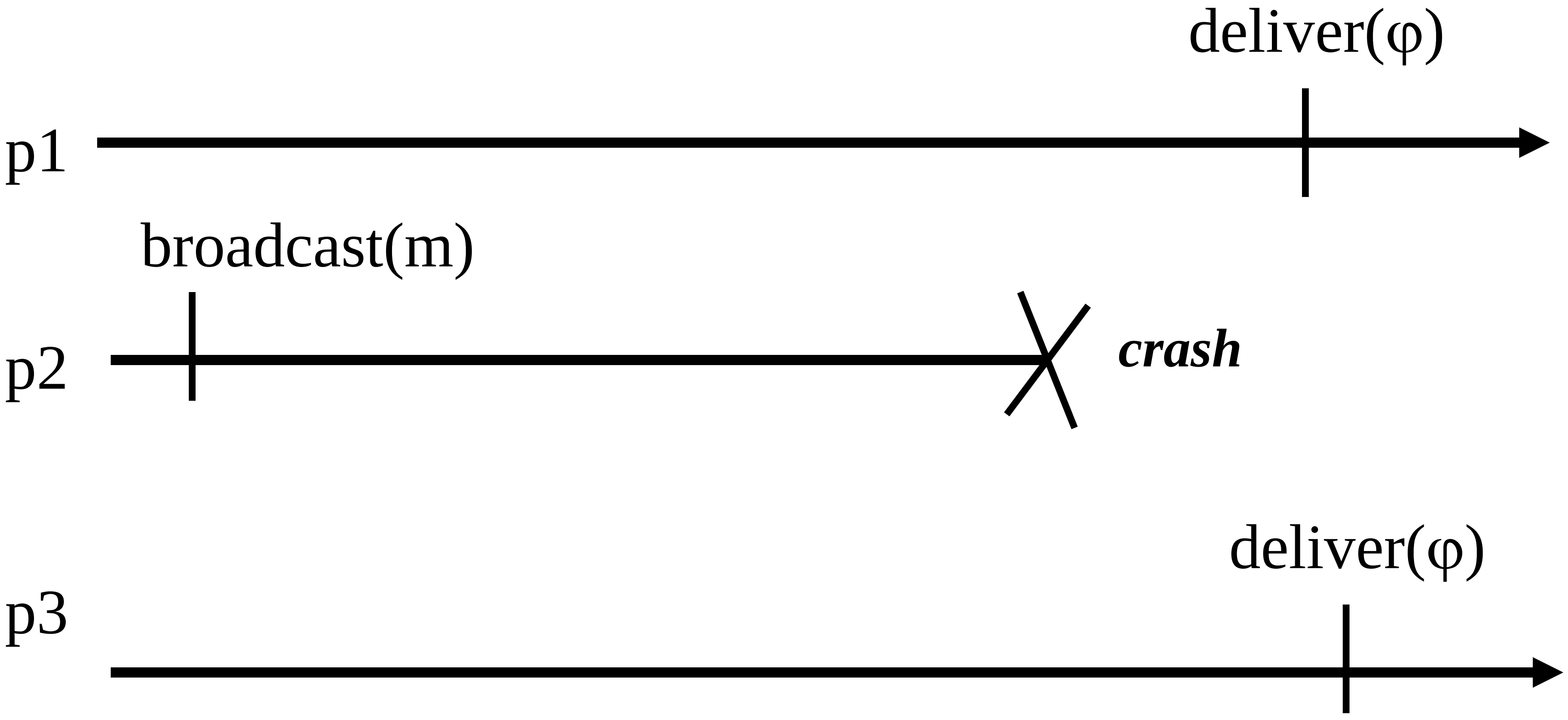
(Uniform) Reliable Broadcast



Terminating Reliable Broadcast



Terminating Reliable Broadcast



Terminating Reliable Broadcast

- ***Like*** with reliable broadcast, correct processes in TRB agree on the set of messages they deliver
- ***Like*** with (uniform) reliable broadcast, every correct process in TRB delivers every message delivered by any process
- ***Unlike*** with reliable broadcast, every correct process delivers a message, even if the broadcaster crashes

Terminating Reliable Broadcast

- The problem is defined for a specific broadcaster process pi = src (known by all processes)
- Process src is supposed to broadcast a message *m* (distinct from φ)
- The other processes need to deliver *m* if src is correct but may deliver φ if src crashes

Terminating Reliable Broadcast (pi)

TRB1. Integrity: If a process delivers a message m, then either m is φ or m was broadcast by src

TRB2. Validity: If the sender *src* is correct and broadcasts a message m, then *src* eventually delivers m

TRB3. (Uniform) Agreement: For any message m, if a correct (any) process delivers m, then every correct process delivers m

TRB4. Termination: Every correct process eventually delivers exactly one message

Terminating Reliable Broadcast

- ***Events***
  - Request: <trbBroadcast, m>
  - Indication: <trbDeliver, p, m>
- ***Properties:***
  - ***TRB1, TRB2, TRB3, TRB4***

Algorithm (trb)

- **Implements:** trbBroadcast (trb).
- **Uses:**
    - BestEffortBroadcast (beb).
    - PerfectFailureDetector (P).
    - Consensus(cons).
- **upon event** < Init > **do**
    - prop := $\perp$;
    - correct := S;

Algorithm (trb – cont’d)

- **upon event** < trbBroadcast, m> **do**
    - **trigger** < bebBroadcast, m>;

- **upon event** < crash, src > and (prop = $\perp$) **do**
    - prop := φ;

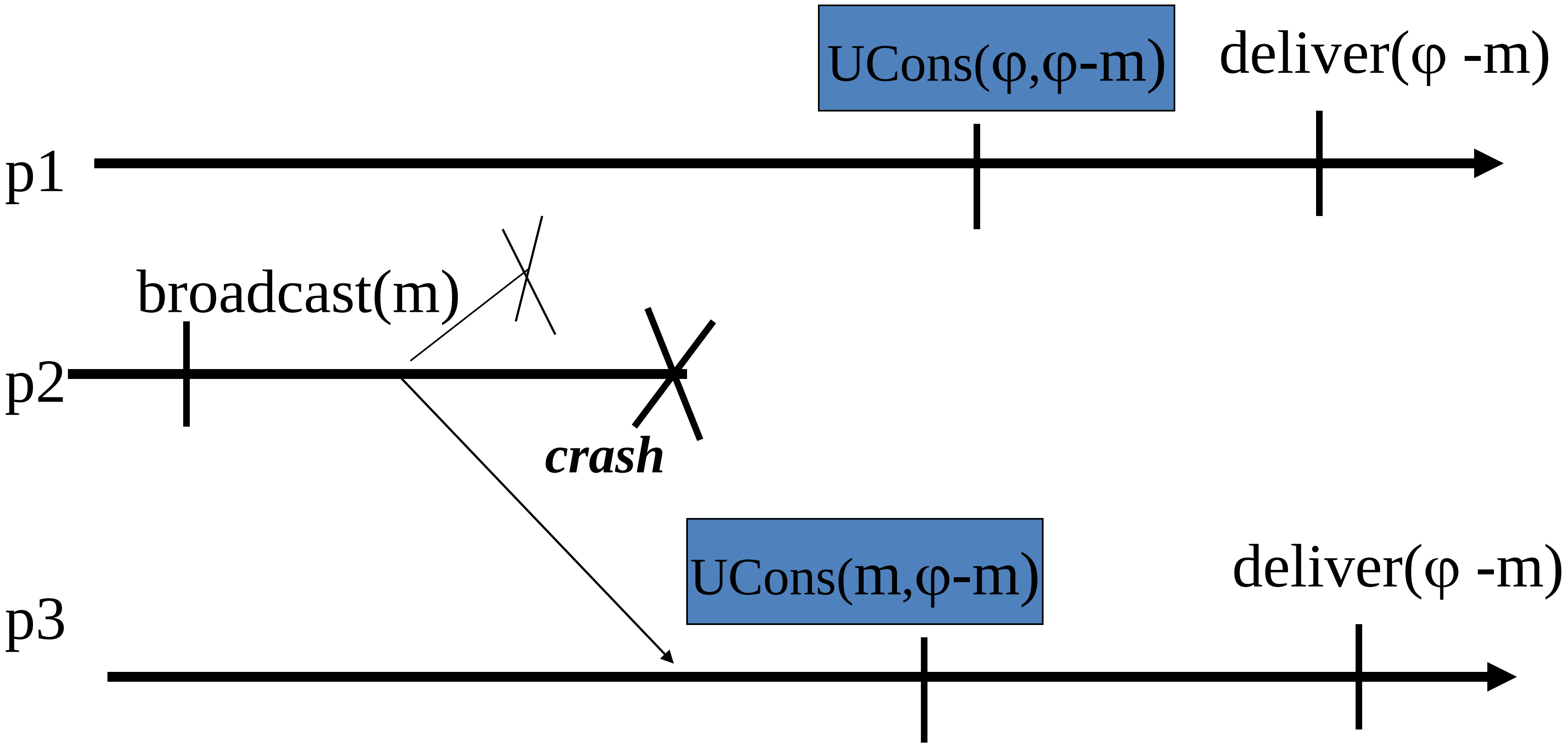
Algorithm (trb – cont'd)

```
upon event <bebDeliver, src, m> and (prop = ⊥) do
    prop := m;

upon event (prop ≠ ⊥) do
    trigger < Propose, prop>;

upon event < Decide, decision> do
    trigger < trbDeliver, src, decision>;
```

Algorithm (trb); src = p2



Terminating Reliable Broadcast

- Our TRB algorithm uses the perfect failure detector P (i.e., P is sufficient)
- Is P also necessary?
  - Is there an algorithm that implements TRB with a failure detector that is strictky weaker than P? (this would mean that P is not necessary)
  - Is there an algorithm that uses TRB to implement P (this would mean that P is necessary)

Terminating Reliable Broadcast

- We give an algorithm that implements **P** using **TRB**; more precisely, we assume that every process pi can use an infinite number of instances of TRB where pi is the sender src
  - 1. Every process pi keeps on trbBroadcasting messages mi1, mi2, etc
  - 2. If a process pk delivers φi, pk suspects pi
  - NB. The algorithm uses (non-uniform) TRB