



Distributed Systems

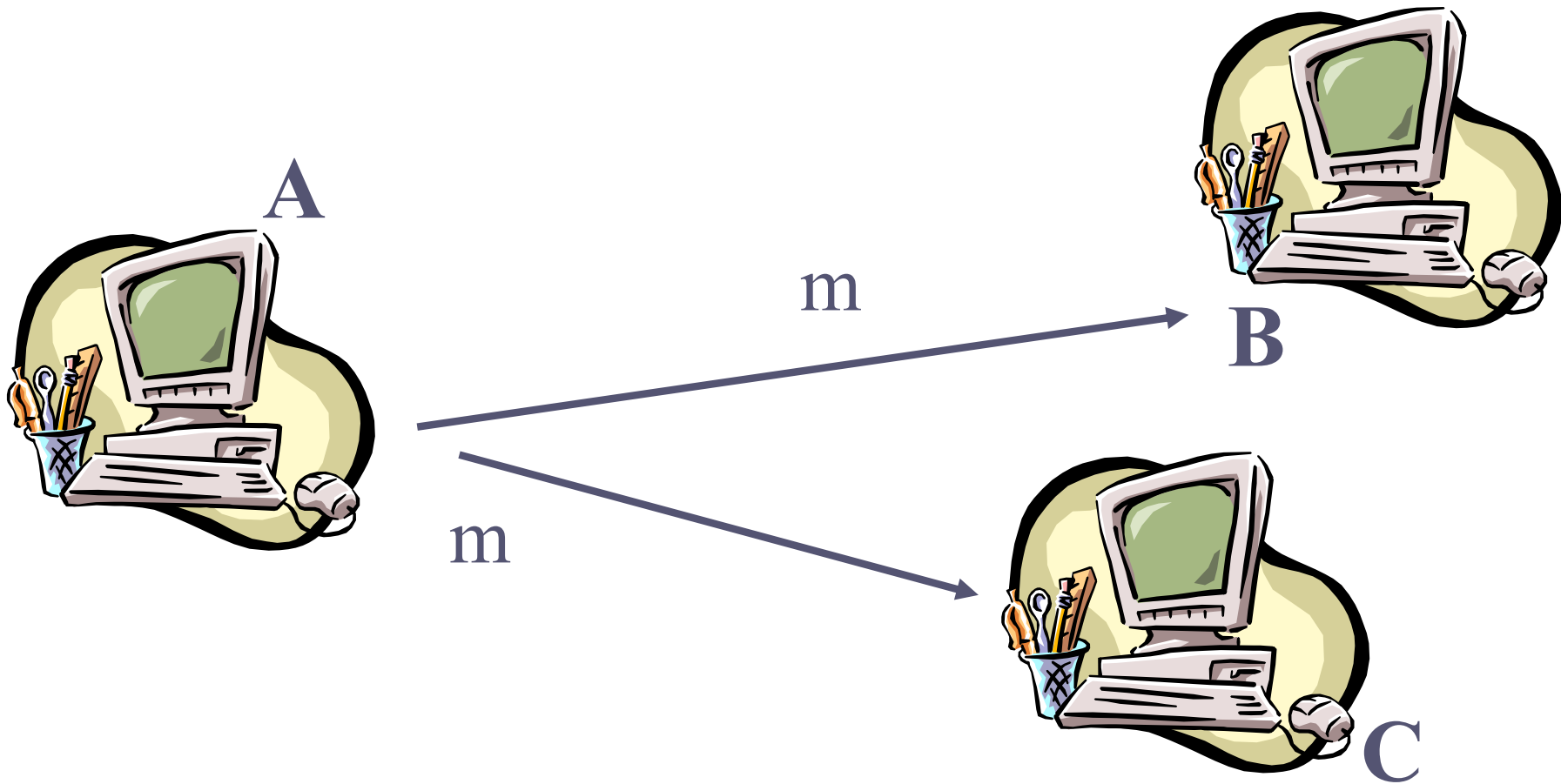
Terminating Reliable
Broadcast

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Terminating Reliable Broadcast

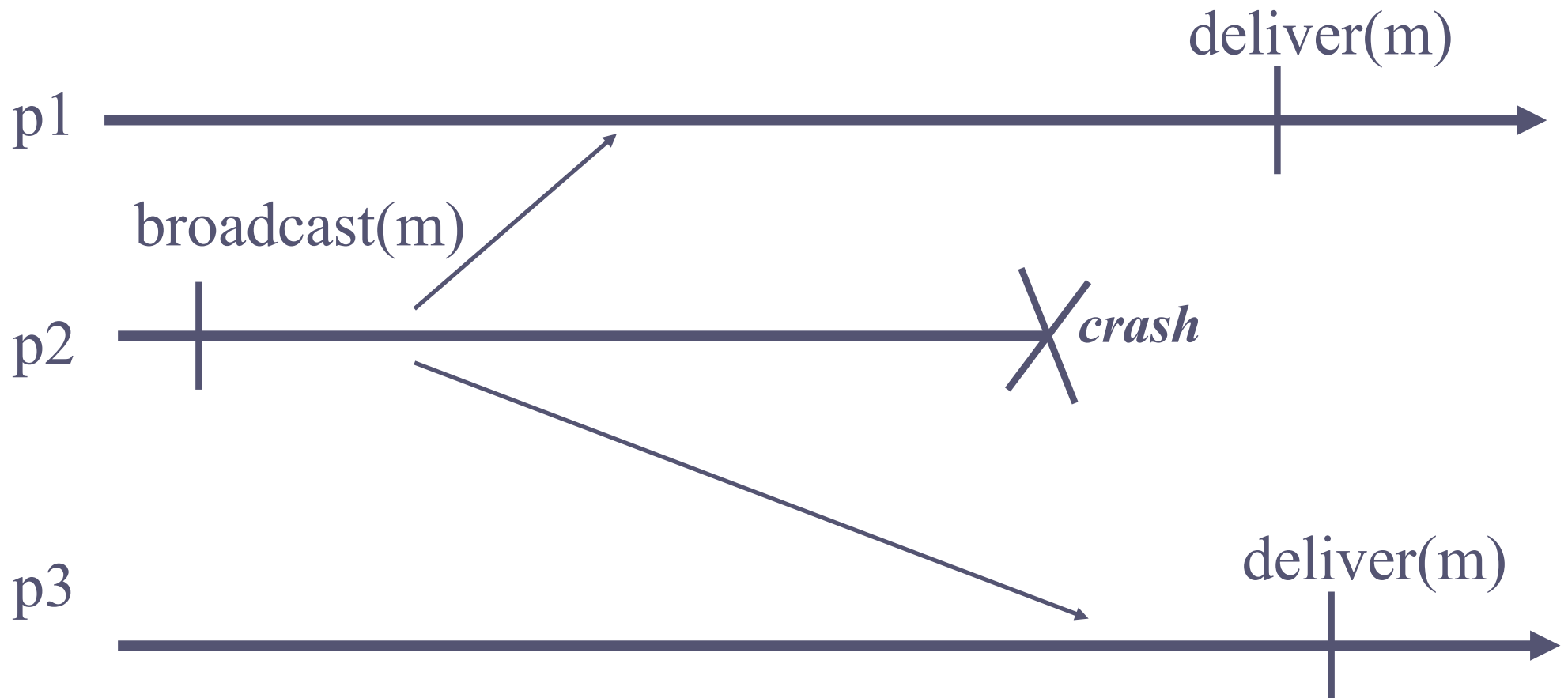




Terminating Reliable Broadcast

- 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

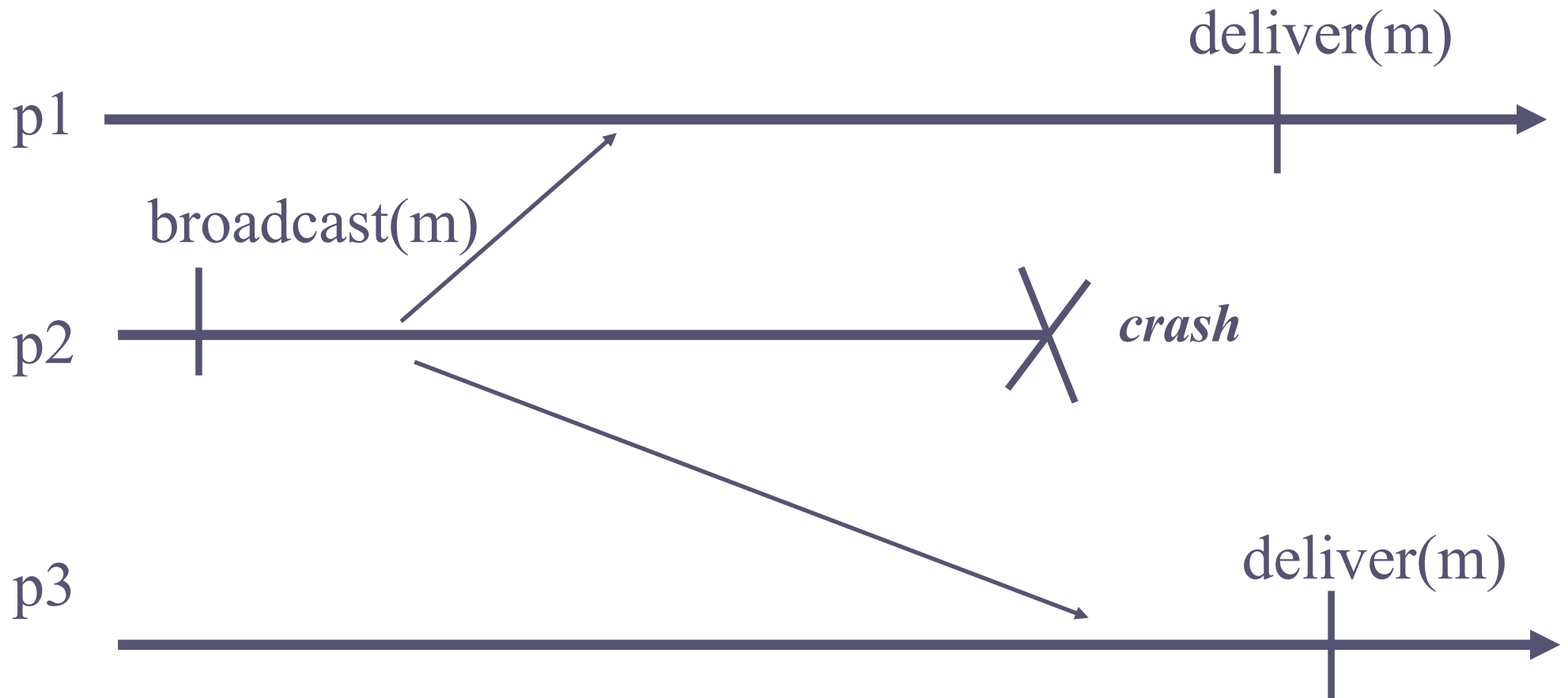
(Uniform) Reliable Broadcast



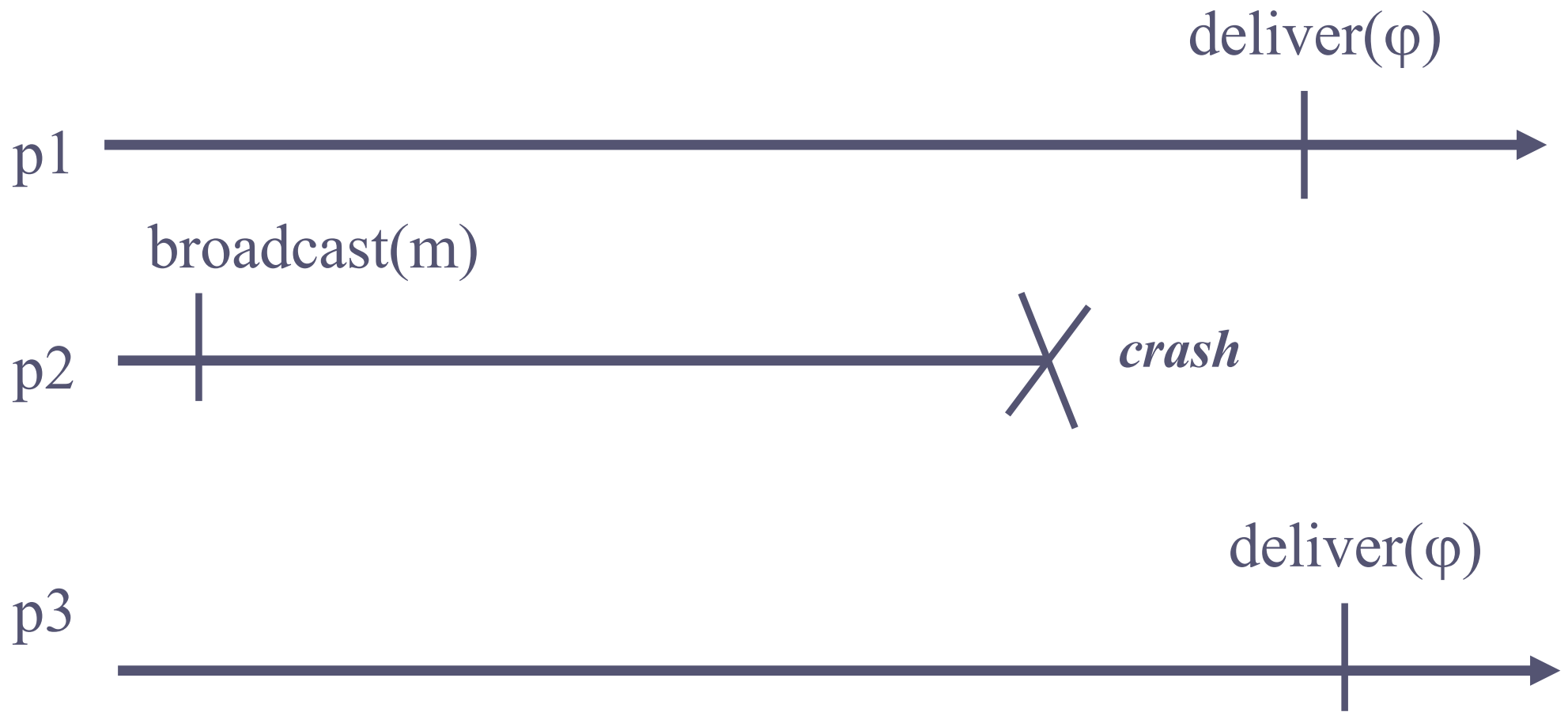
(Uniform) Reliable Broadcast



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 $p_i = \text{src}$ (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: $\langle \text{trbBroadcast}, m \rangle$
- Indication: $\langle \text{trbDeliver}, p, m \rangle$

• *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;

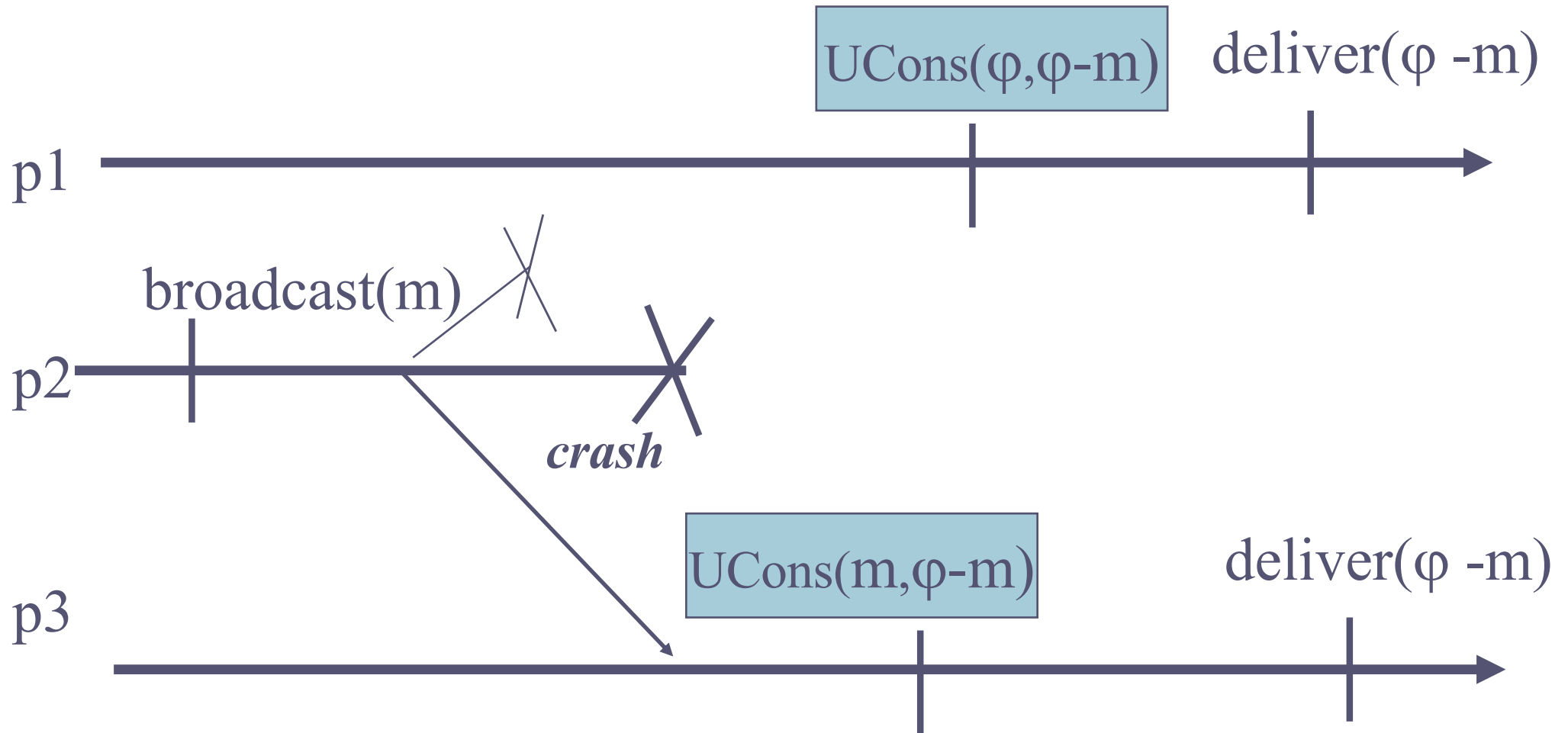
Algorithm (trb – cont'd)

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

Algorithm (trb – cont'd)

- **upon event** $\langle \text{bebDeliver}, \text{src}, \text{m} \rangle$ and $(\text{prop} = \perp)$ **do**
 - $\text{prop} := \text{m};$
- **upon event** $(\text{prop} \neq \perp)$ **do**
 - **trigger** $\langle \text{Propose}, \text{prop} \rangle;$
- **upon event** $\langle \text{Decide}, \text{decision} \rangle$ **do**
 - **trigger** $\langle \text{trbDeliver}, \text{src}, \text{decision} \rangle;$

Algorithm (trb); src = p2



Terminating Reliable Broadcast

- The 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 strictly 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 p_i can use an infinite number of instances of TRB where p_i is the sender src
 - 1. Every process p_i keeps on trbBroadcasting messages $m_{i1}, m_{i2}, \text{ etc}$
 - 2. If a process p_k delivers φ_i , p_k suspects p_i