CLOUD COMPUTING CONCEPTS

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SNAPSHOTS

Lecture C

CONSISTENT CUTS

Cuts

- **Cut = time frontier at each process and at each channel**
- **Events at the process/channel that happen before the cut are “in the cut”**
  - And happening after the cut are “out of the cut”

Consistent Cuts

Consistent Cut: a cut that obeys causality

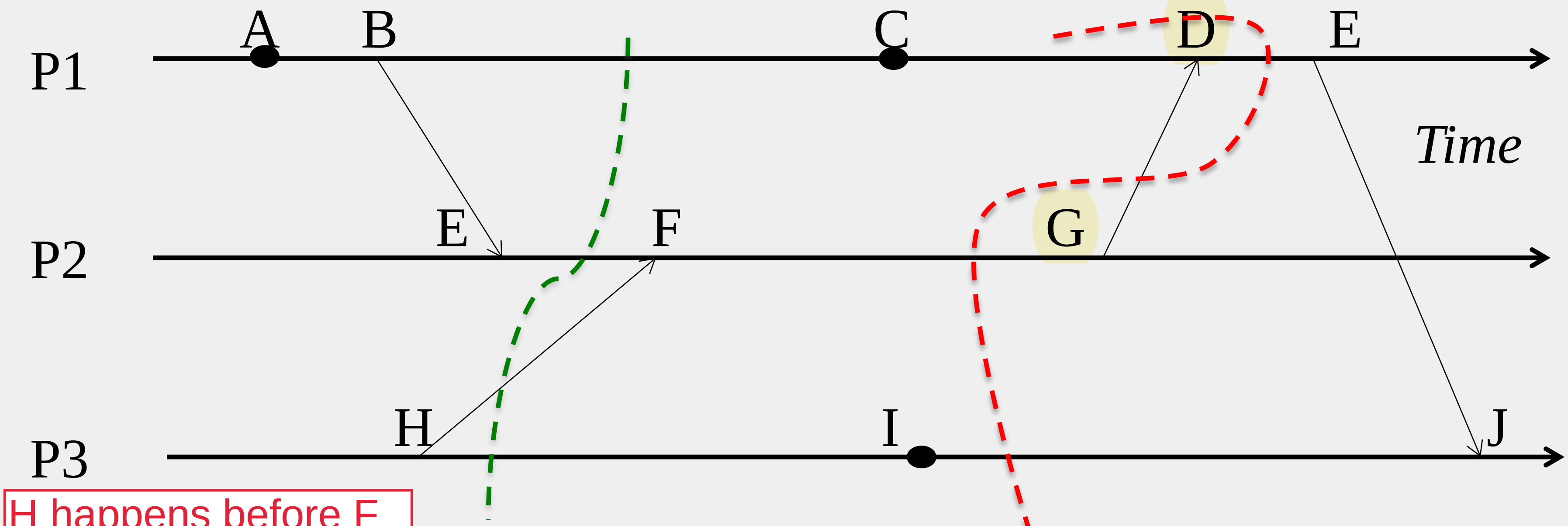
- A cut C is a consistent cut if and only if:

  for (each pair of events e, f in the system)

  - Such that event e is in the cut C, and if f → e (f happens-before e)
    - Then: Event f is also in the cut C

Example

G == send event
D == receive event
inconsistent == D in the cut G not. BUT G happens before D

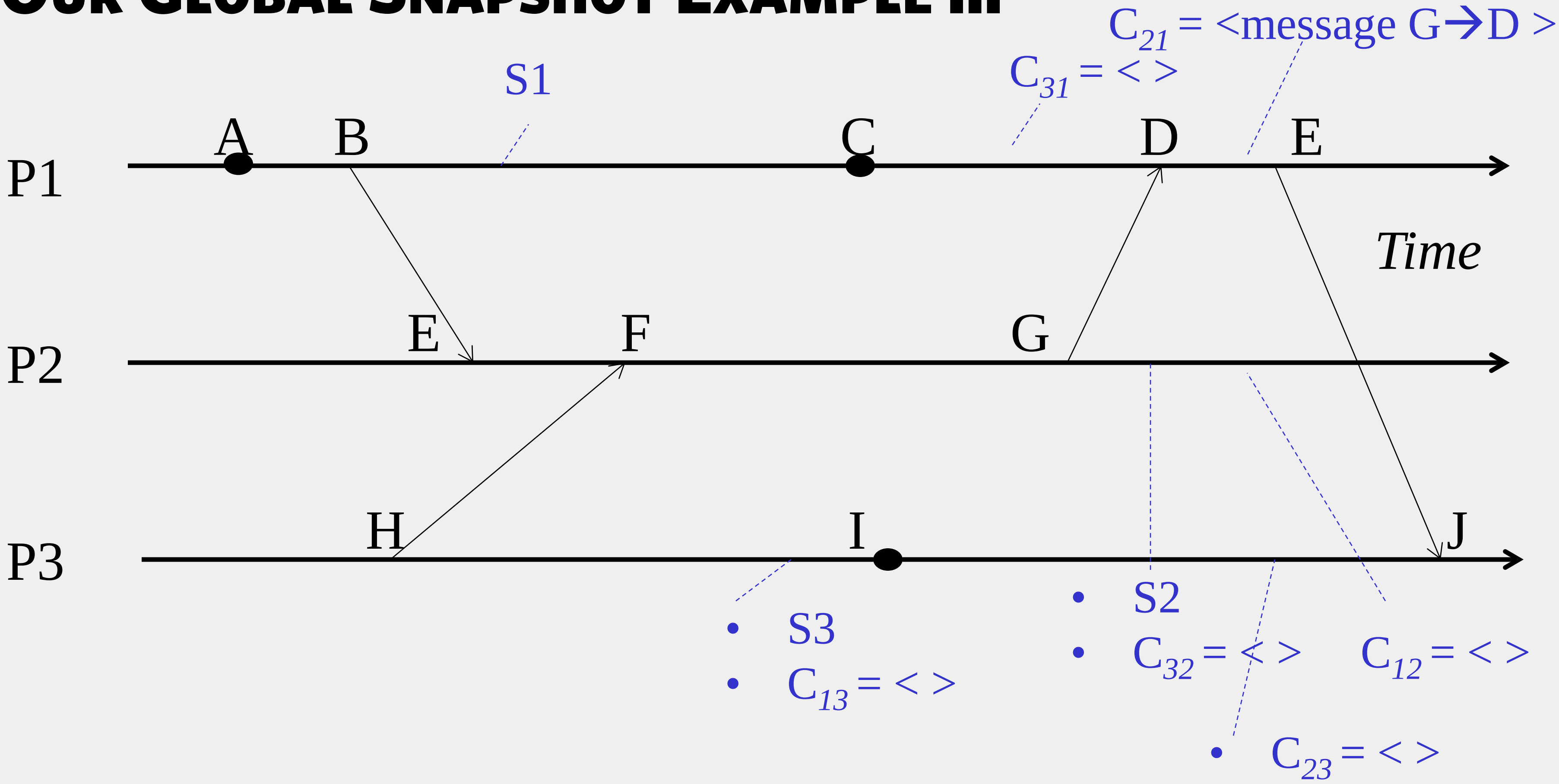


H happens before F
== a cut thru them
still consistent cut

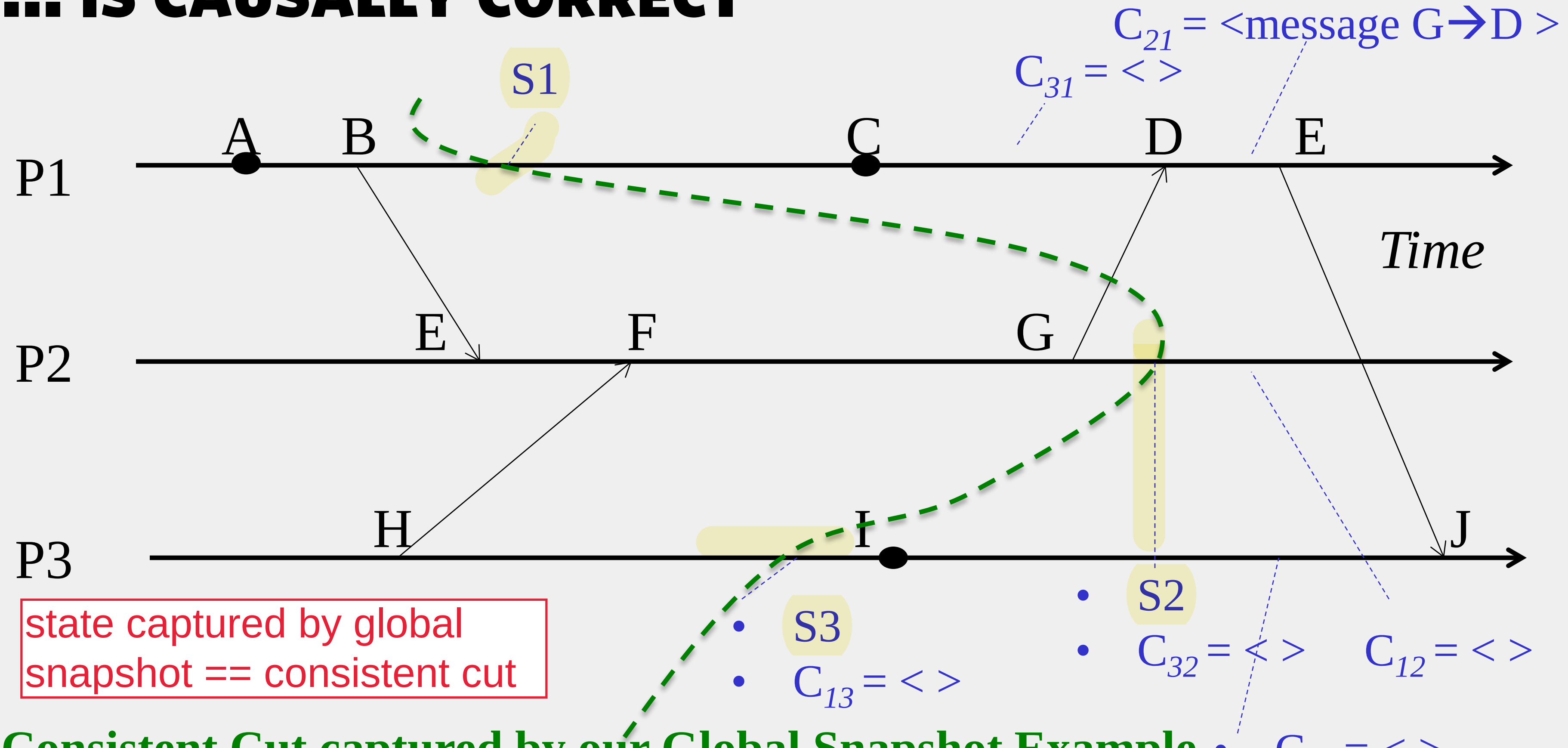
Consistent Cut

Inconsistent Cut
G → D, but only D is in cut

Our Global Snapshot Example …



… IS CAUSALLY CORRECT



state captured by global snapshot == consistent cut

Consistent Cut captured by our Global Snapshot Example

In fact…

- Any run of the Chandy-Lamport Global Snapshot algorithm creates a consistent cut

Chandy-Lamport Global Snapshot algorithm creates a consistent cut

Let's quickly look at the proof

- Let e_i and e_j be events occurring at P*i* and P*j*, respectively, such that
  - $e_i \rightarrow e_j$ (e_i happens before e_j)
- The snapshot algorithm ensures that

  if e_j is in the cut then e_i is also in the cut.

- That is: if $e_j \rightarrow$ <P*j* records its state>, then
  - It must be true that $e_i \rightarrow$ <P*i* records its state>.

Chandy-Lamport Global Snapshot algorithm creates a consistent cut

- **If e_j → <P*j* records its state>, then it must be true that e_i → <P*i* records its state>.**
  - By contradiction, suppose e_j → <P*j* records its state> and <P*i* records its state> → e_i
  - Consider the path of app messages (through other processes) that go from e_i → e_j
  - Due to FIFO ordering, markers on each link in above path will precede regular app messages
  - Thus, since <P*i* records its state> → e_i , it must be true that P*j* received a marker before e_j
  - Thus e_j is not in the cut => contradiction

Next

- What is the Chandy-Lamport algorithm used for?