



CLOUD COMPUTING CONCEPTS

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SNAPSHOTS

Lecture A

WHAT IS GLOBAL SNAPSHOT

HERE'S A SNAPSHOT



DISTRIBUTED SNAPSHOT

- More often, each country's representative is sitting in their respective capital and sending messages to each other (say emails).
- How do you calculate a “global snapshot” in that distributed system?
- What does a “global snapshot” even mean?

IN THE CLOUD

- **In a cloud: each application or service is running on multiple servers**
- **Servers handling concurrent events and interacting with each other**
- **The ability to obtain a “global photograph” of the system is important**
- **Some uses of having a global picture of the system**
 - **Checkpointing**: can restart distributed application on failure
 - **Garbage collection of objects**: objects at servers that don't have any other objects (at any servers) with pointers to them
 - **Deadlock detection**: Useful in database transaction systems
 - **Termination of computation**: Useful in batch computing systems like Folding@Home, SETI@Home

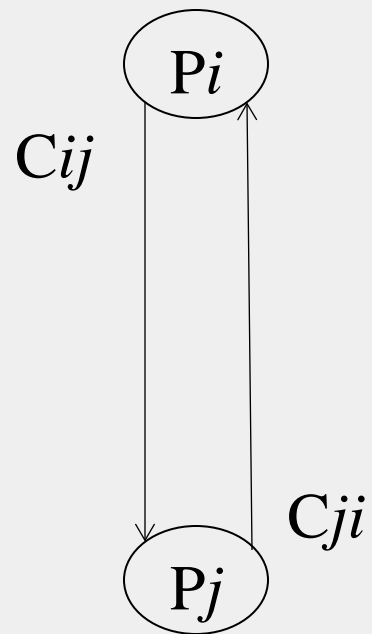
WHAT'S A GLOBAL SNAPSHOT?

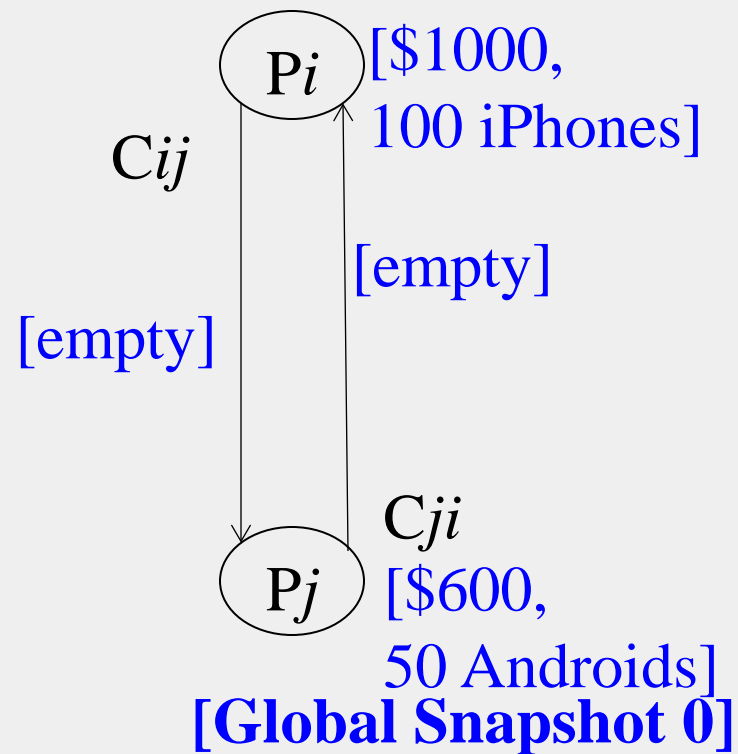
- **Global Snapshot = Global State =**
Individual state of each process in the distributed system
+
Individual state of each communication channel in the distributed system
- Capture the *instantaneous state* of each process
- And the instantaneous *state* of each communication channel, i.e., *messages* in transit on the channels

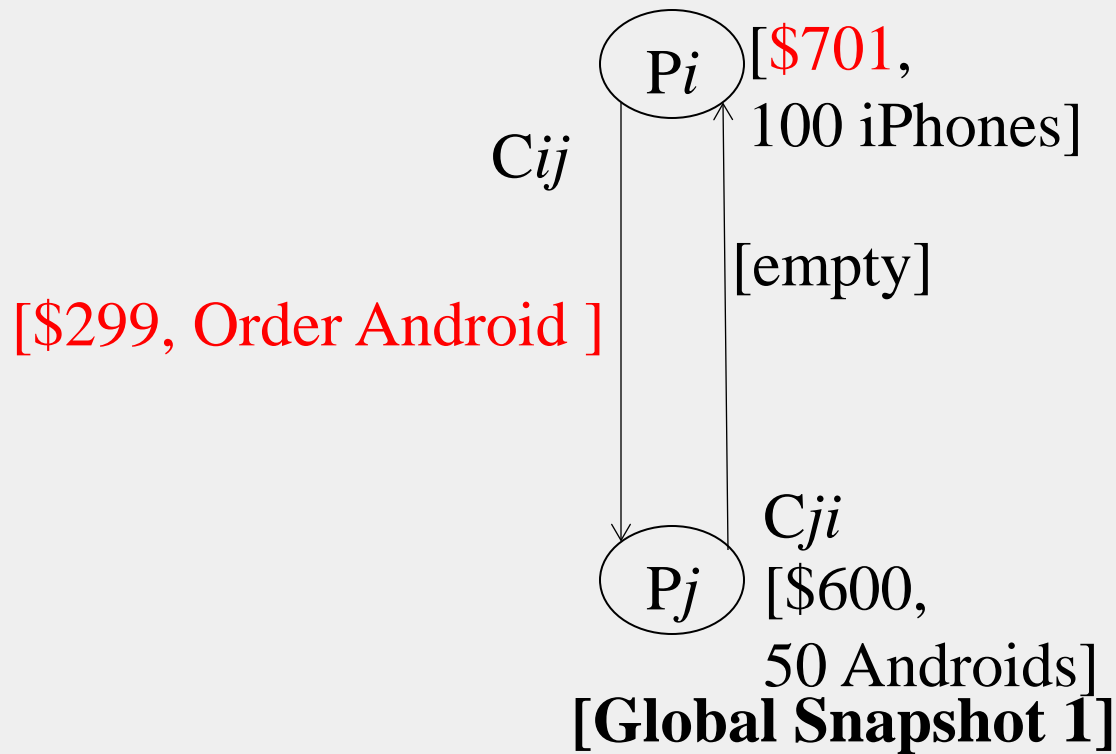
OBVIOUS FIRST SOLUTION

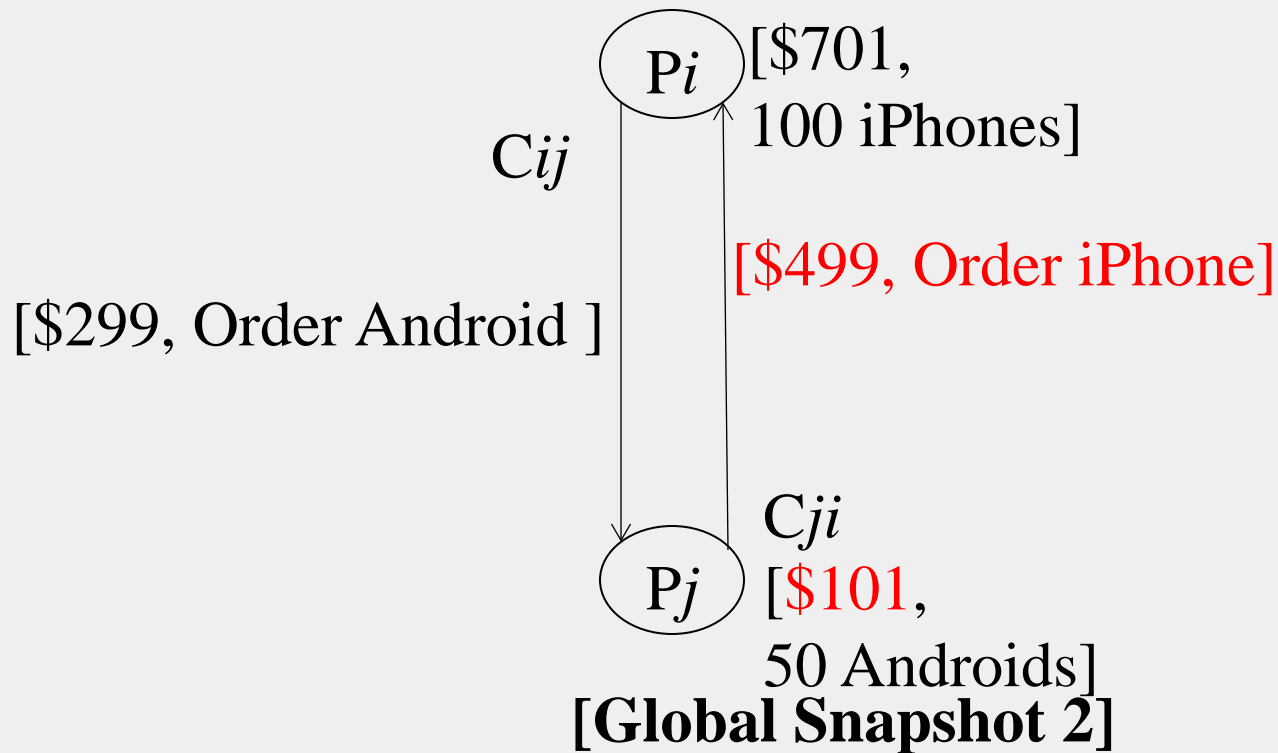
- Synchronize clocks of all processes
- Ask all processes to record their states at known time t
- Problems?
 - Time synchronization always has error
 - Your bank might inform you, “We lost the state of our distributed cluster due to a 1 ms clock skew in our snapshot algorithm.”
 - Also, does not record the state of messages in the channels
- Again: synchronization not required – causality is enough!

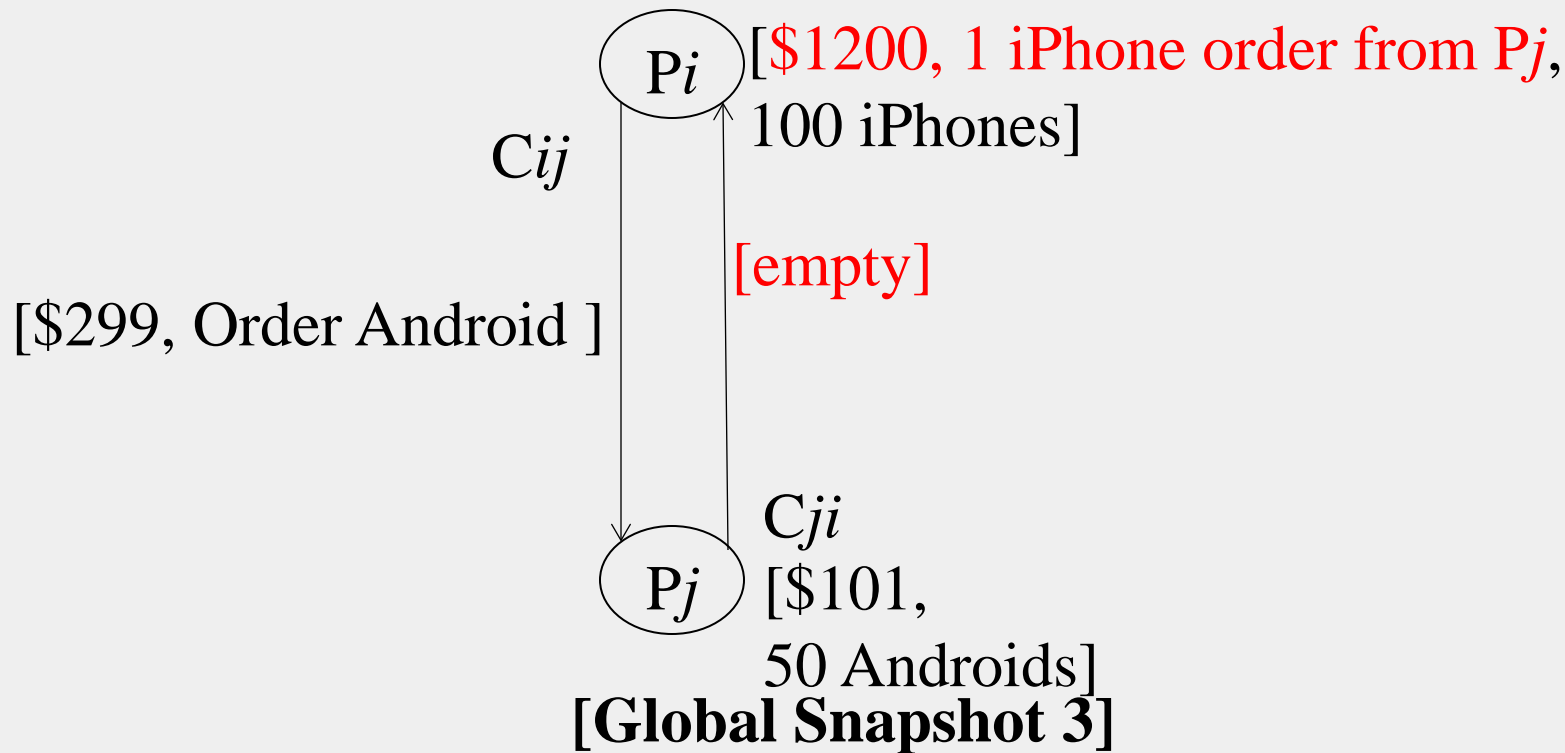
EXAMPLE

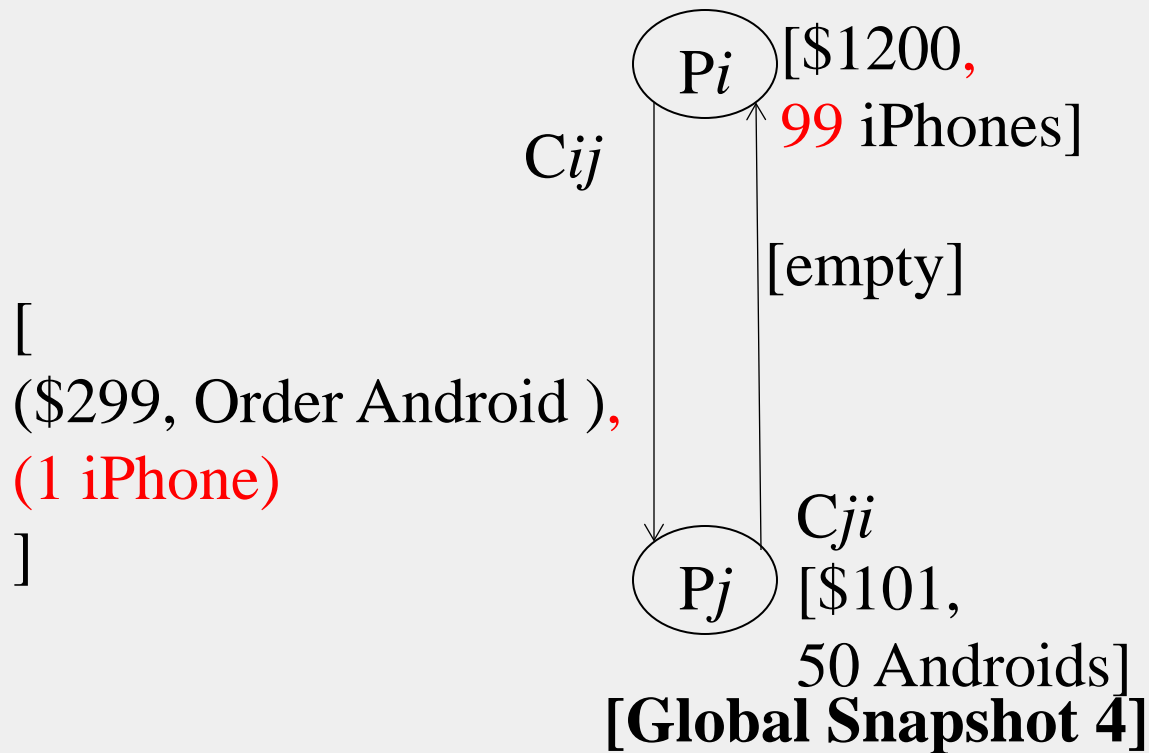




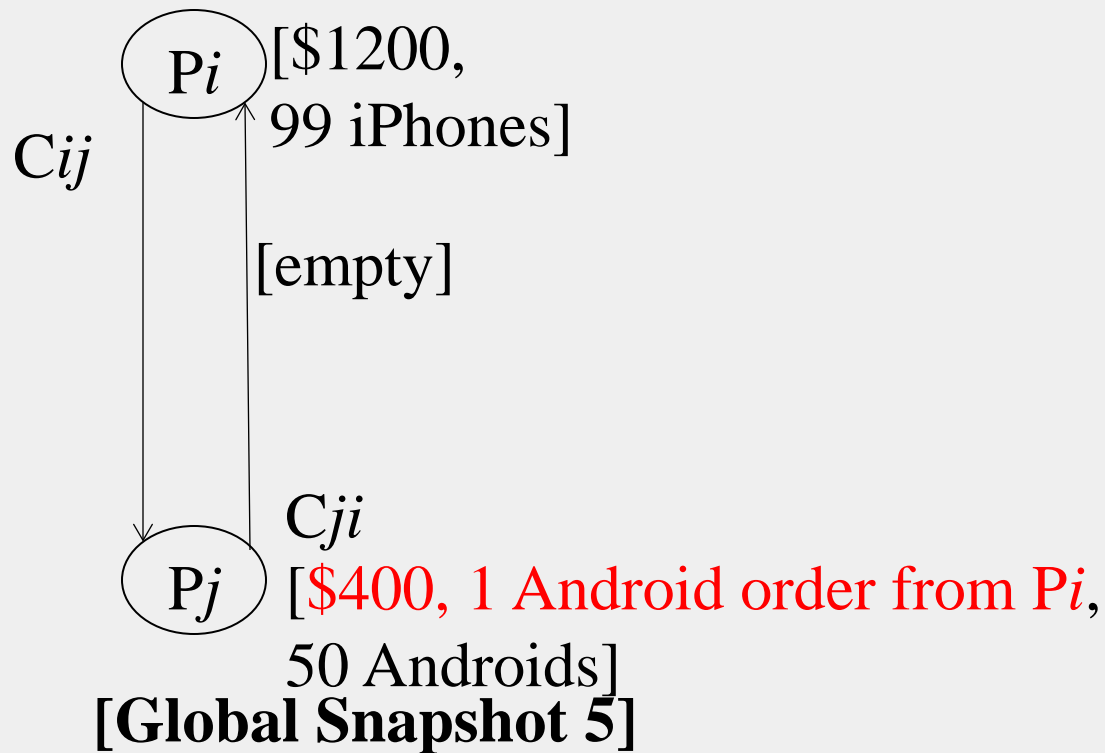


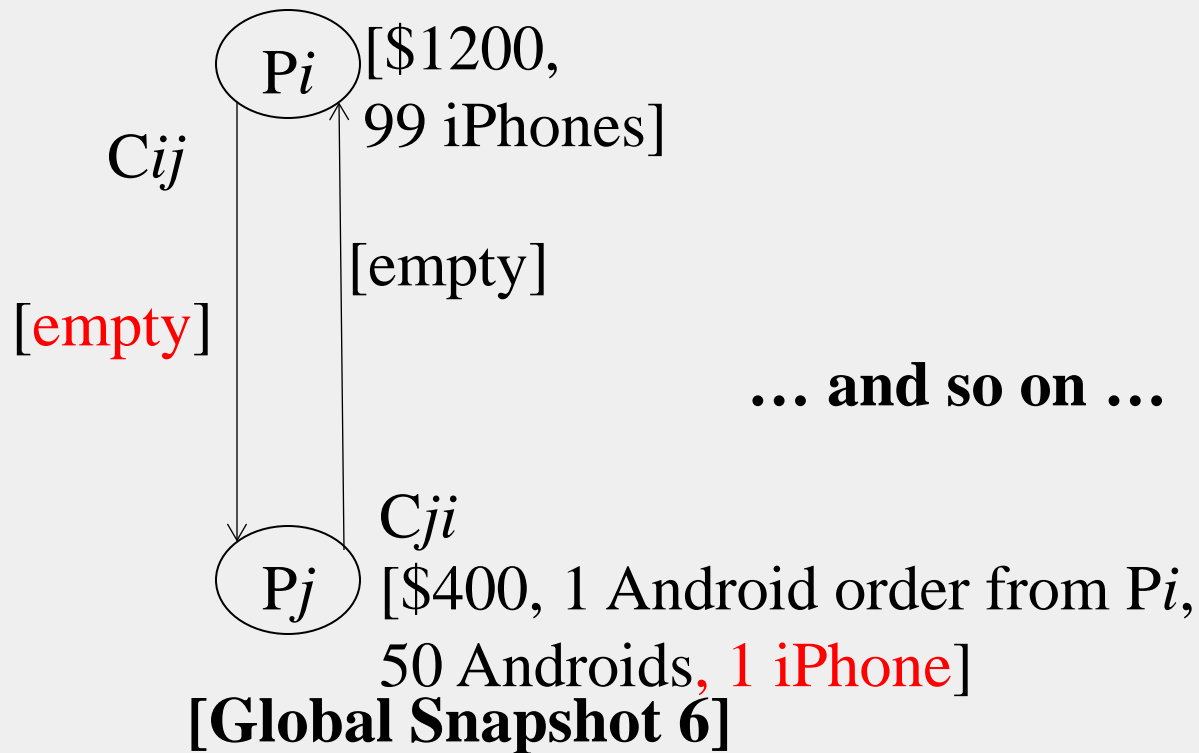






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MOVING FROM STATE TO STATE

- **Whenever an event happens anywhere in the system, the global state changes**
 - Process receives message
 - Process sends message
 - Process takes a step
- **State to state movement obeys causality**
 - Next: Causal algorithm for Global Snapshot calculation