Chapter 5
Limitations of a Distr. System

• Lack of global clock
  • common clock? Synchronized clocks?

• Absence of shared memory
  – cannot obtain a “coherent” view of “global” state
  – coherence ==> state observations made at the same time.
Temporal fundamentals

– Happened before relation (-->)
  • a --> b iff
    – a occurred before b in the same process
    – a is the event of sending a message in a process and b is the
      event of receiving the same message by another process
  • --> is transitive
  • a can causally affect b if a --> b
  • if ! ( (a --> b) and (b --> a) ) then a || b (concurrent). a and b do
    not have a causal relationship.
Lamport’s Logical Clocks

– Consider a “clock” $C_i$ associated with process $P_i$. It is simply a process which assigns a number $C_i(a)$ to any event $a$ in the process such that $C(a) < C(b)$ if $a \rightarrow b$
  • $C_i(a) < C_i(b)$ if $a$ and $b$ in the same process and $a \rightarrow b$
  • $C_i(a) < C_j(b)$ if $a$ is send$(m)$ in $P_i$ and $b$ is recv$(m)$ in $P_j$

– To make the above true
  • $C_i$ should monotonically increase between successive events within a process ($C_i = C_i + d$)
  • every message sent is stamped with the $C_i$ of the sending process. On receipt, the receiver sets its $C_j$ to the greater of its present value or the received timestamp ($\max(C_j, tstamp+d)$)

– This can be thought of as “virtual” time, but it moves only in response to events.
Limitations

– Since each clock can “independently” advance, we cannot in general infer happened before, and hence causality from clock value relations