# Update Support for Database Views via Cooperation

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# The Update Problem for Database Views

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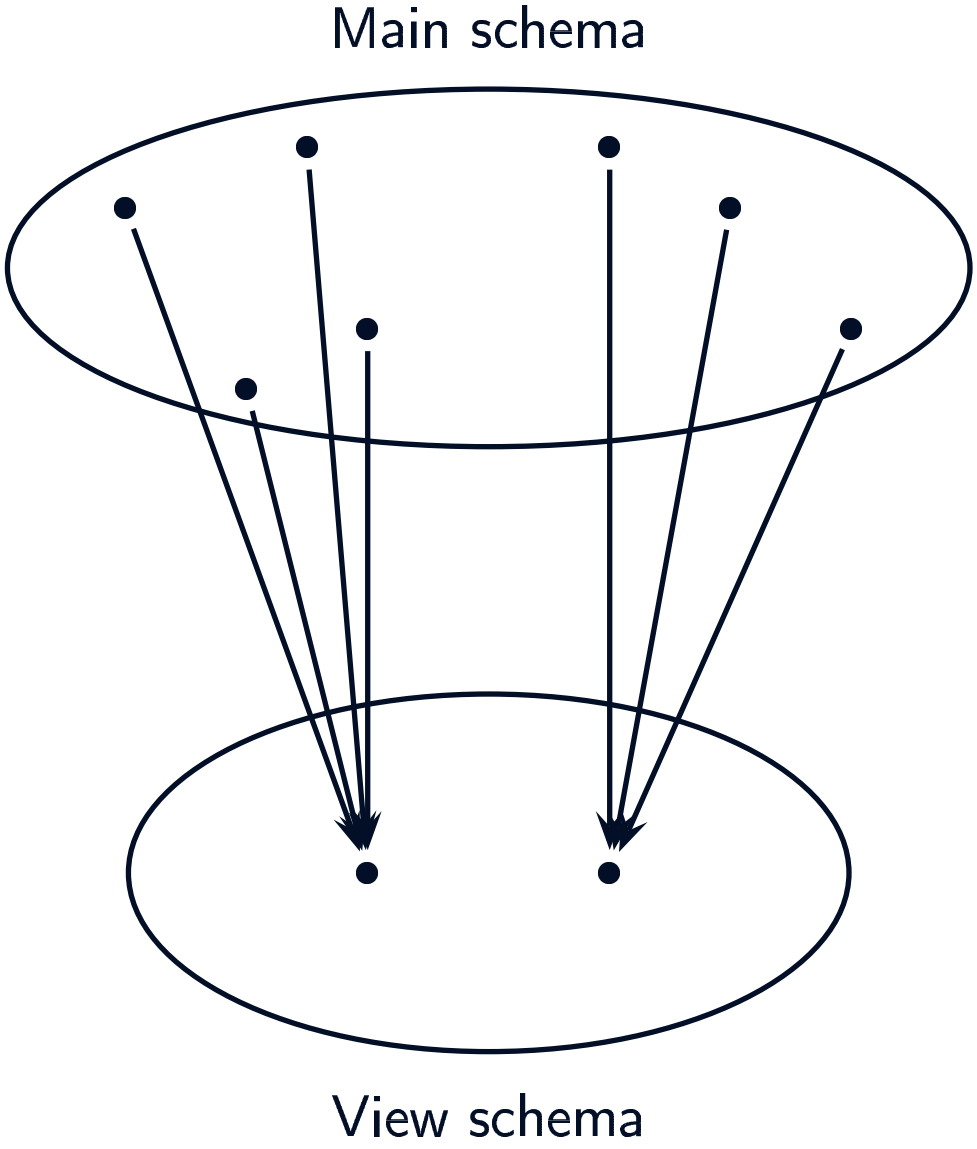

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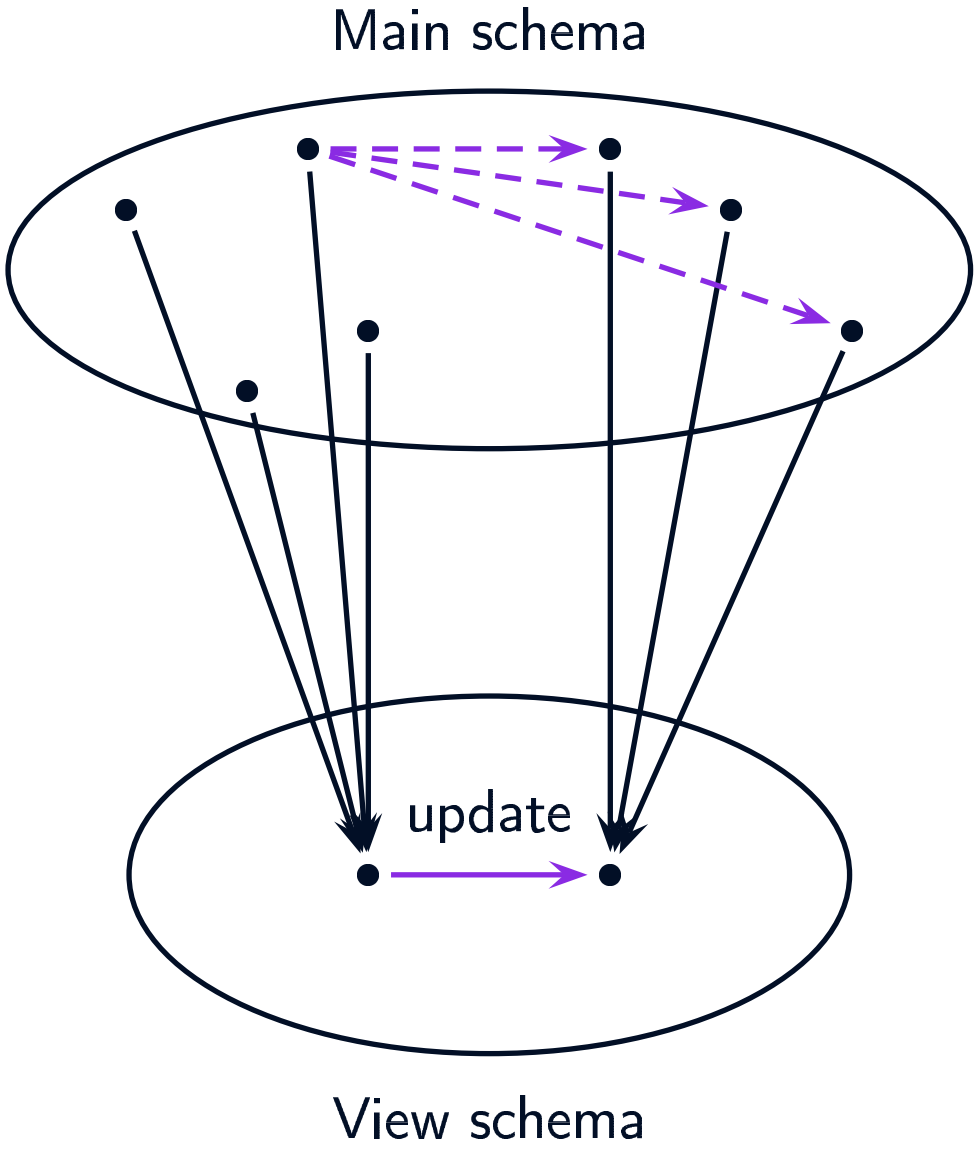

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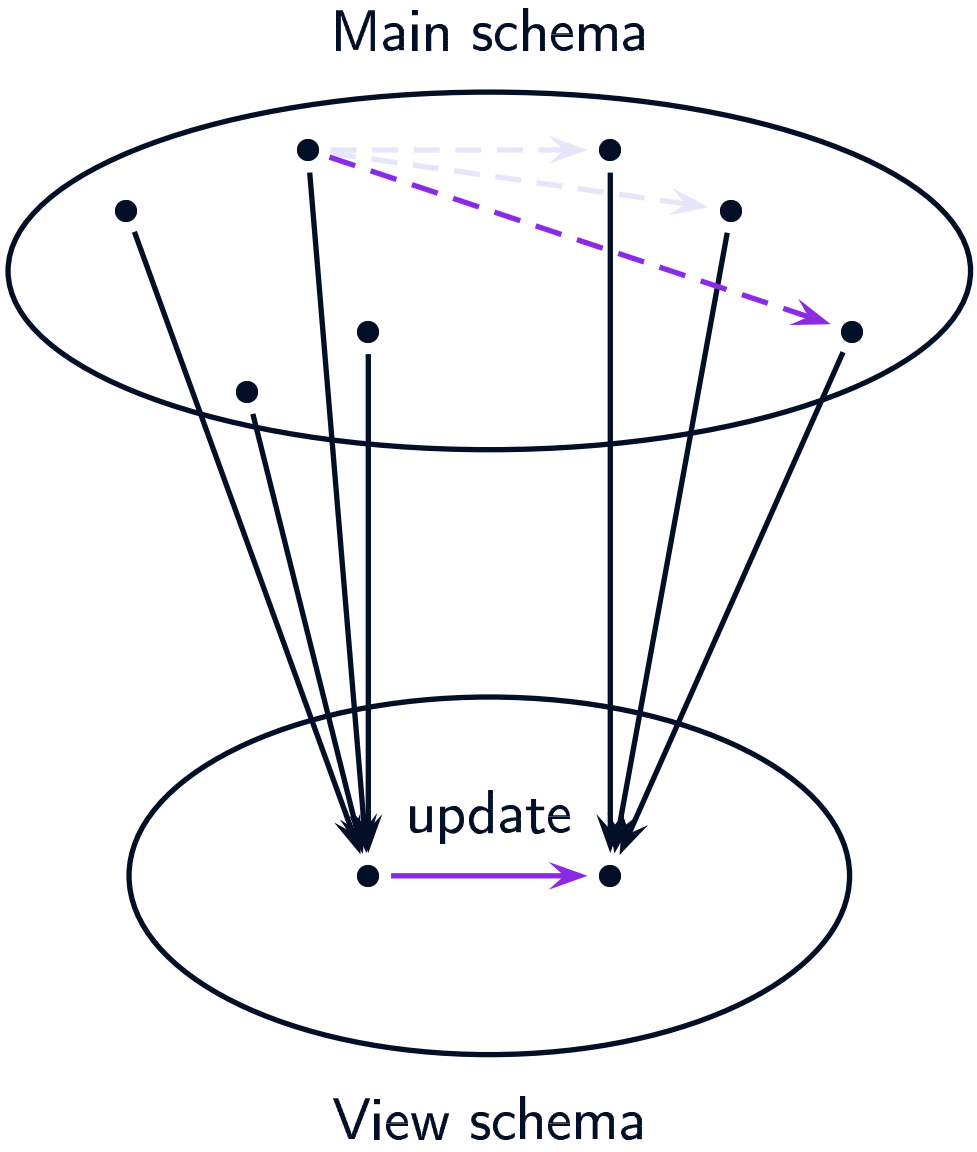

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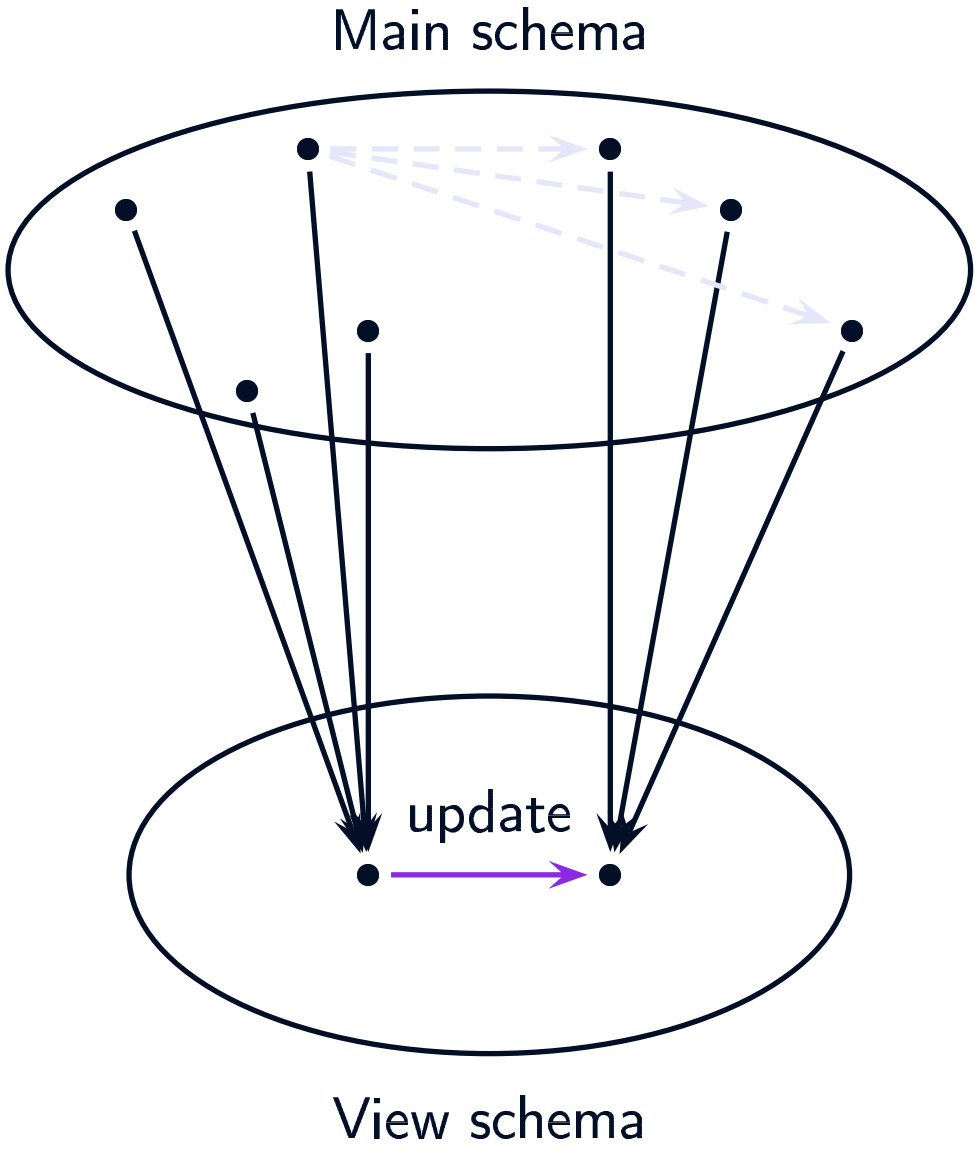
- Depending upon the definition of suitability, it may not be the case that every view update has a suitable translation.



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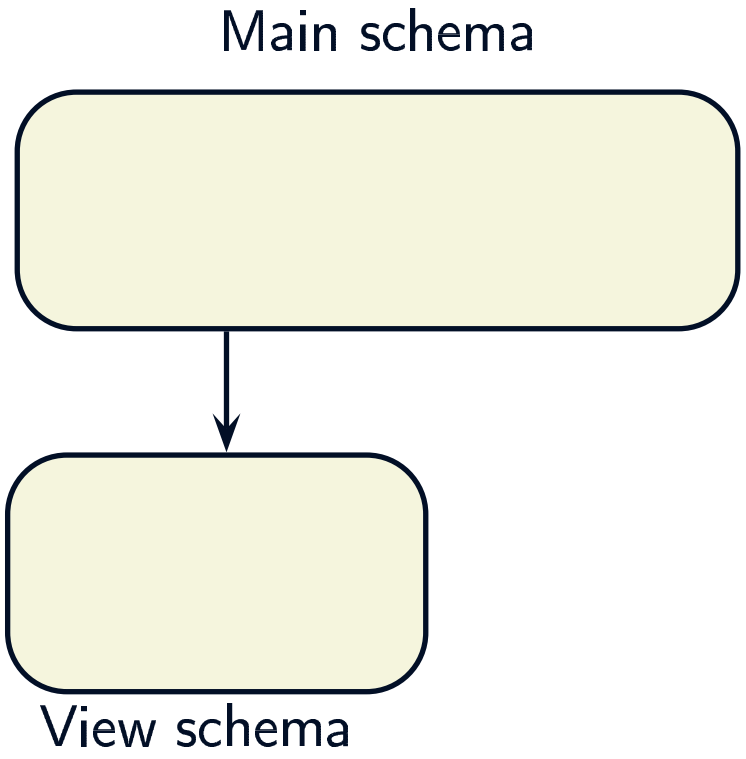

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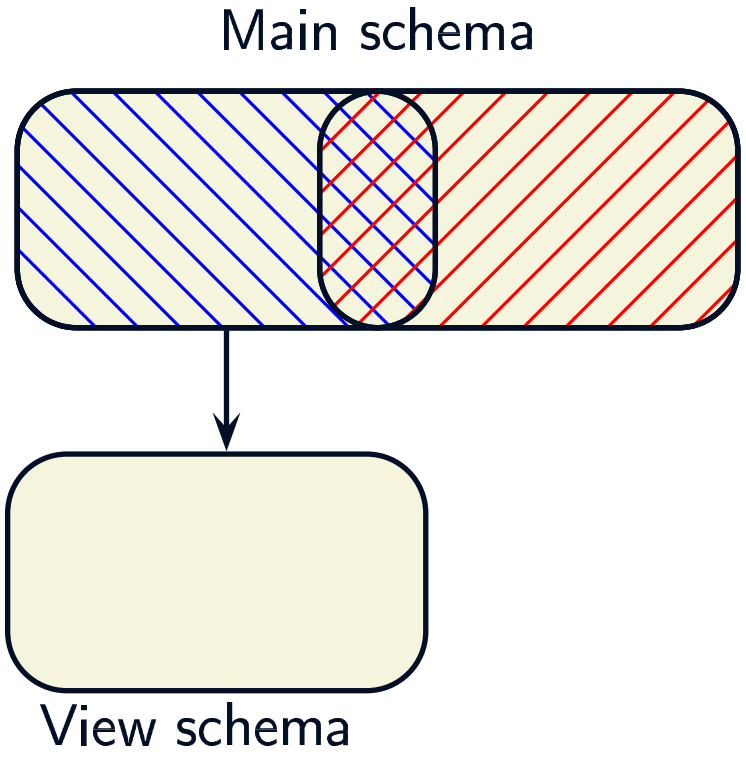

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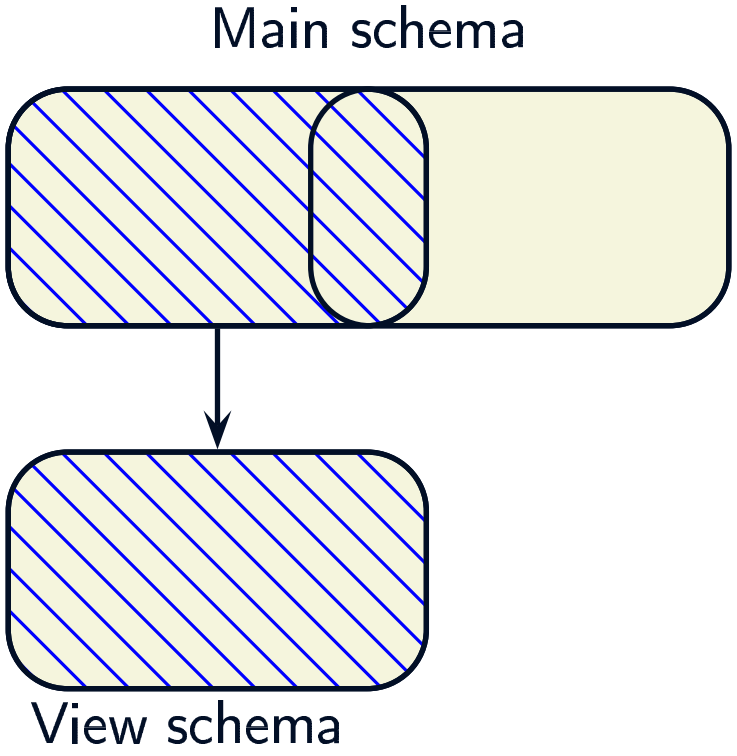

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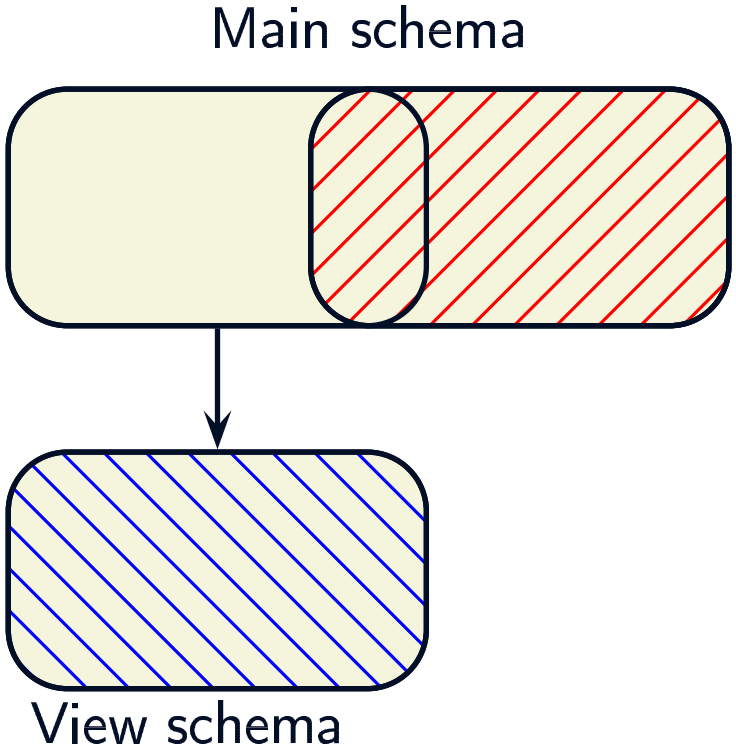

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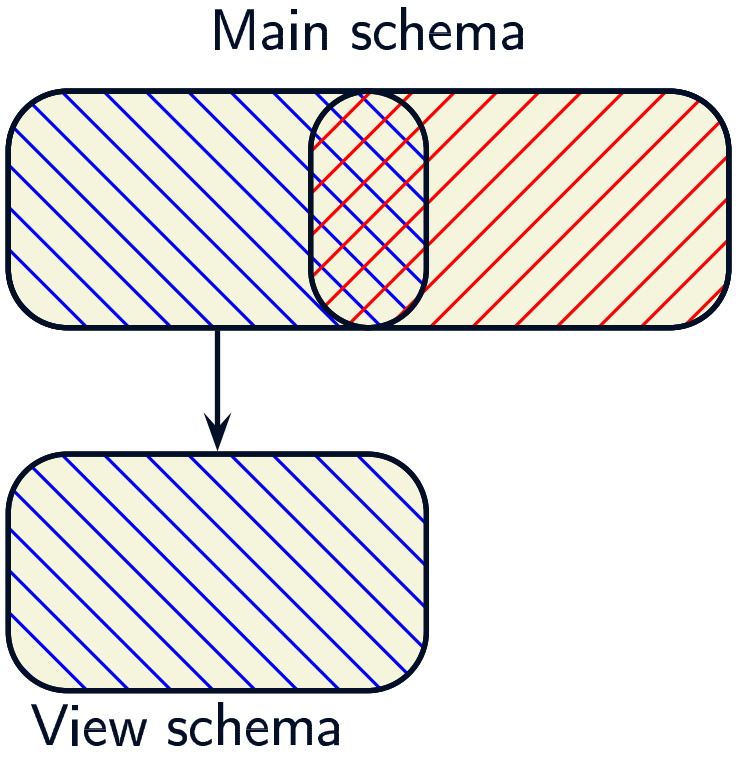

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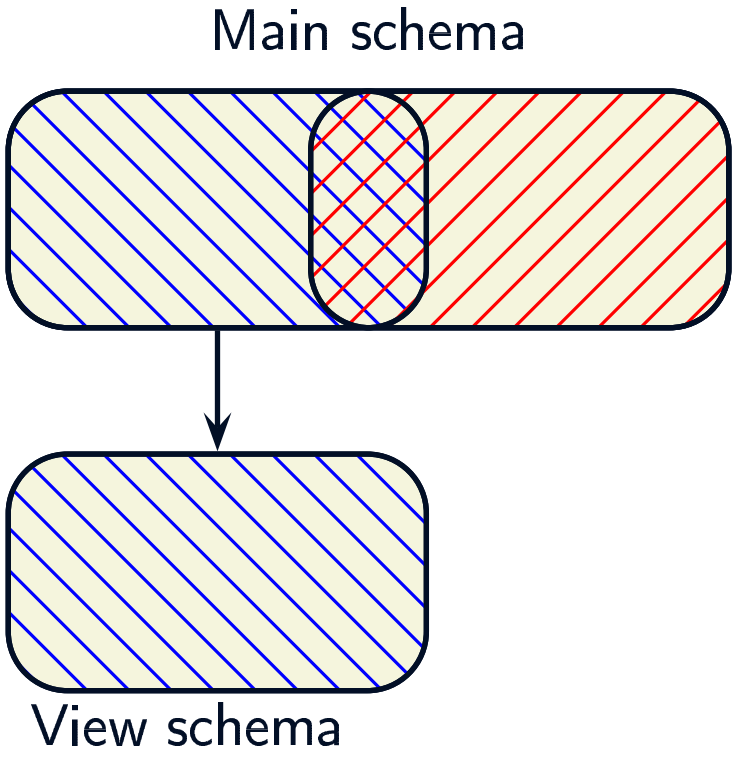


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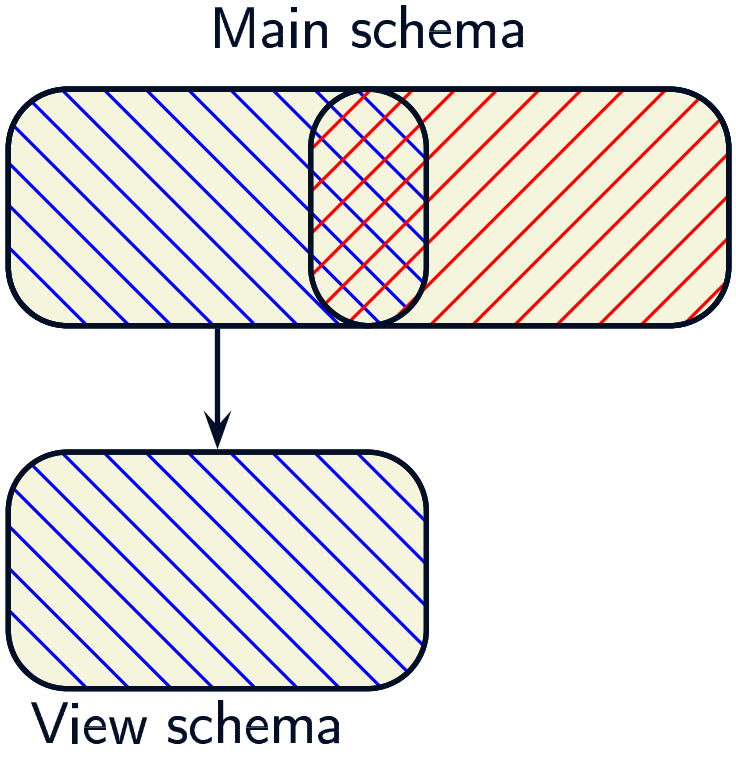


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**Question**: How can updates which are not supported by constant complement be realized?

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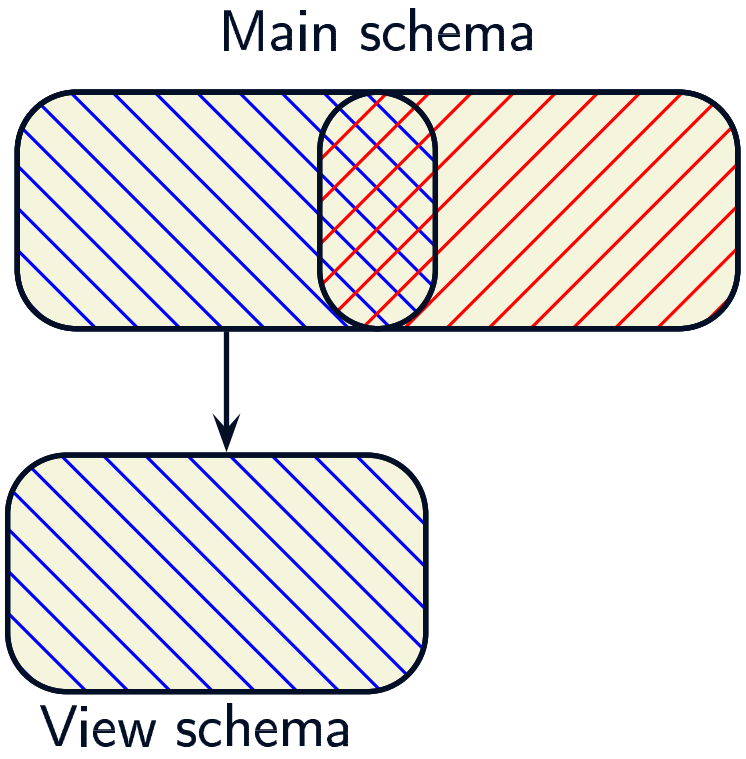

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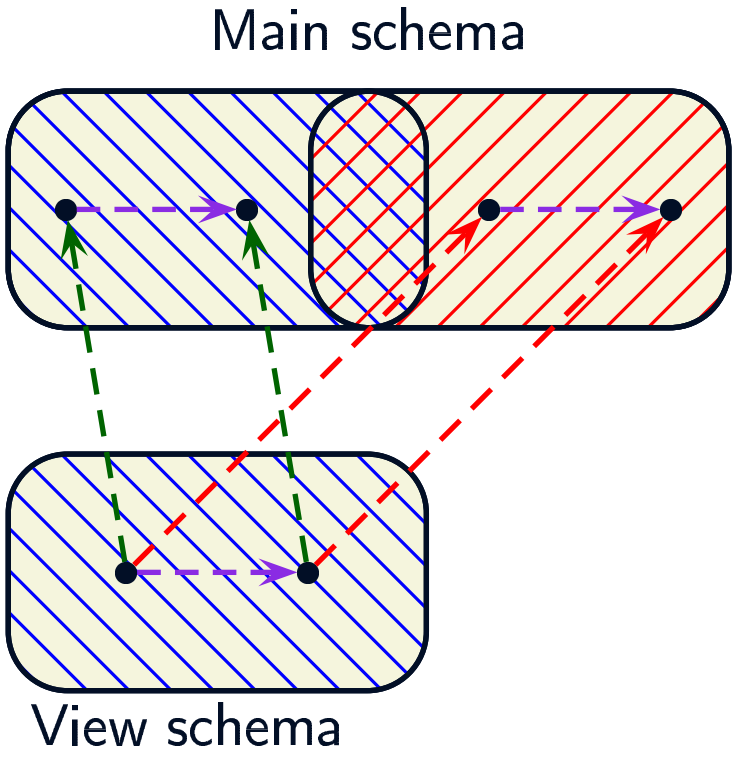

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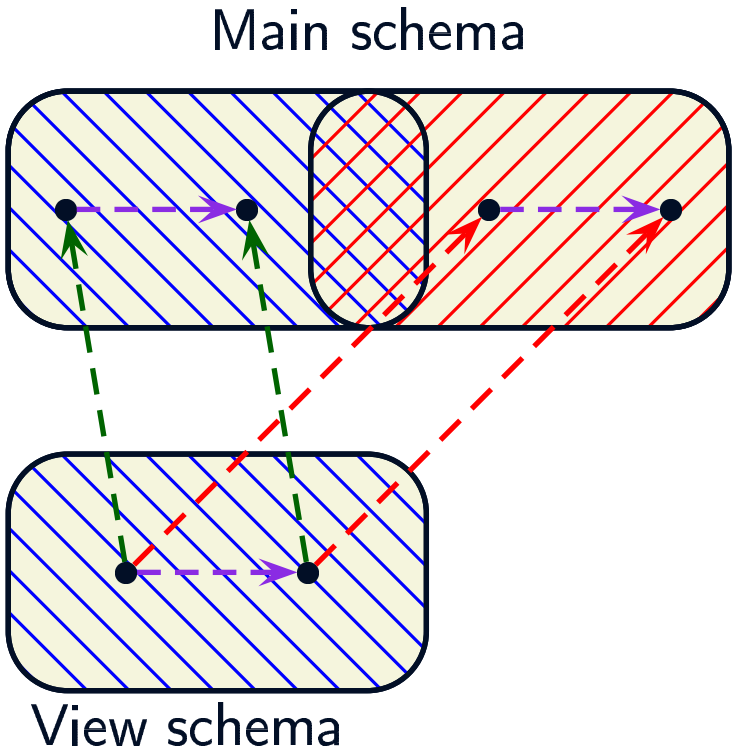

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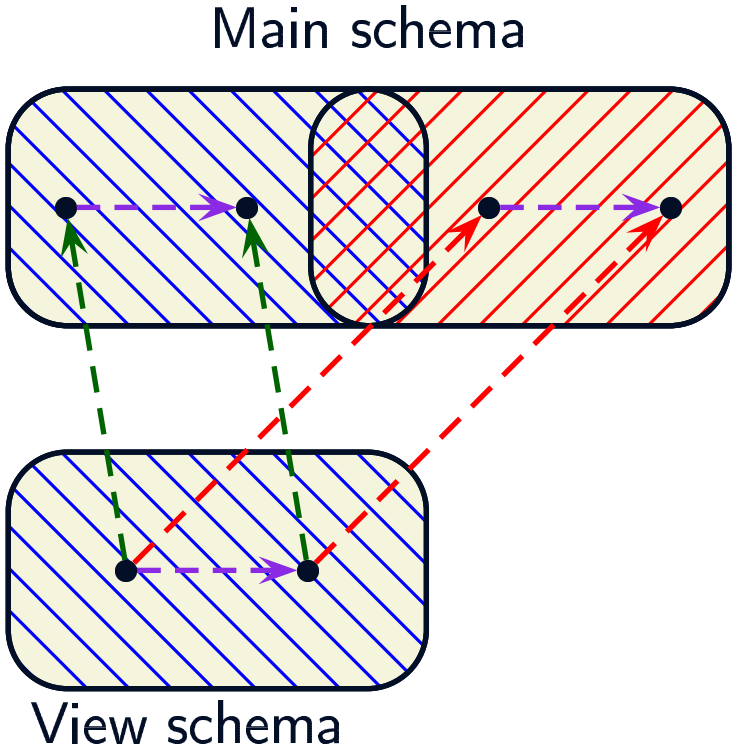


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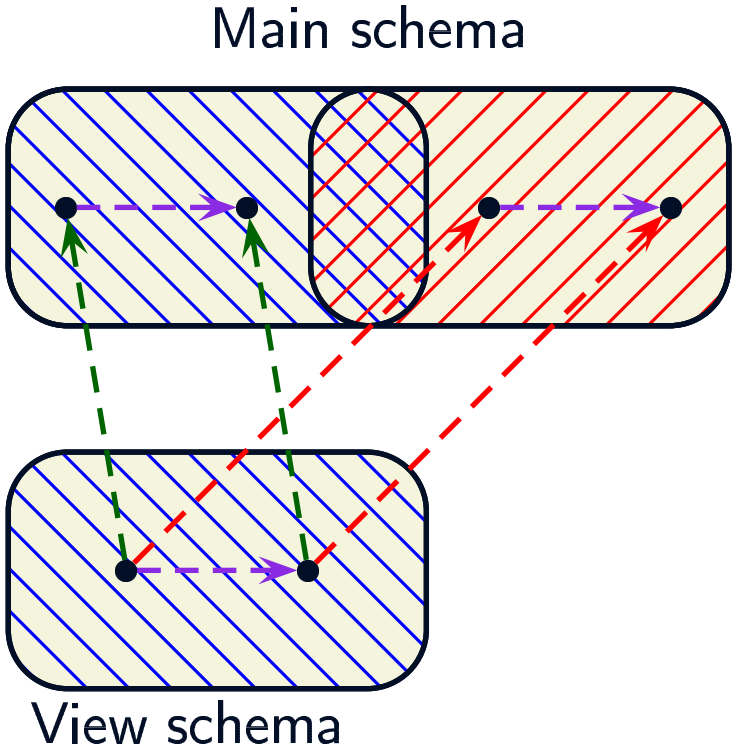


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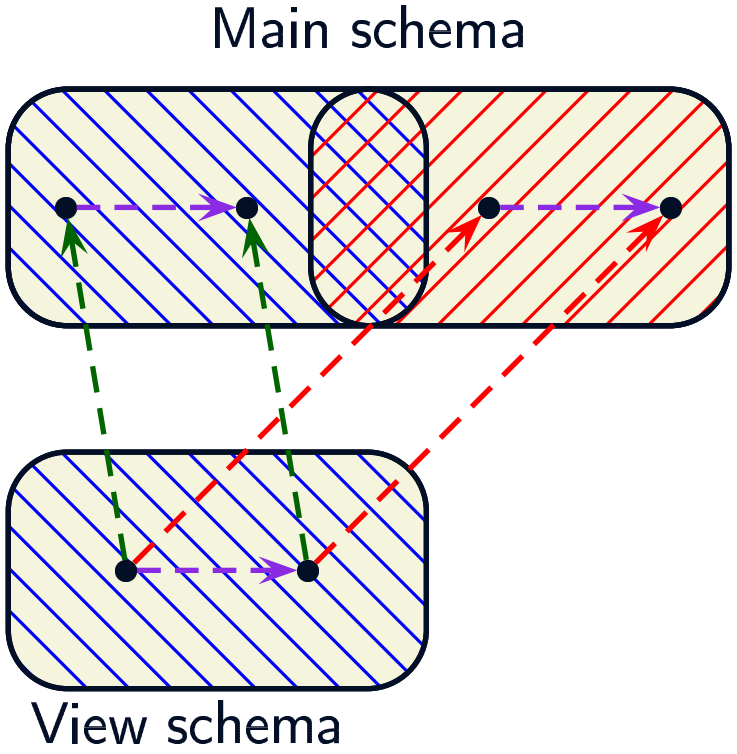


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- All users operate within the limits of their vision of the main schema and their access rights.

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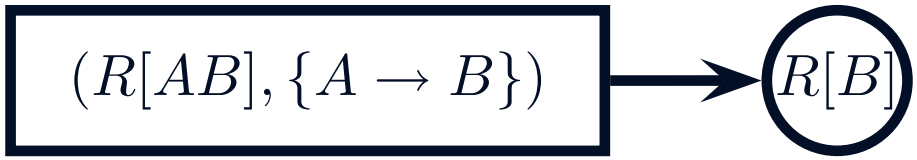

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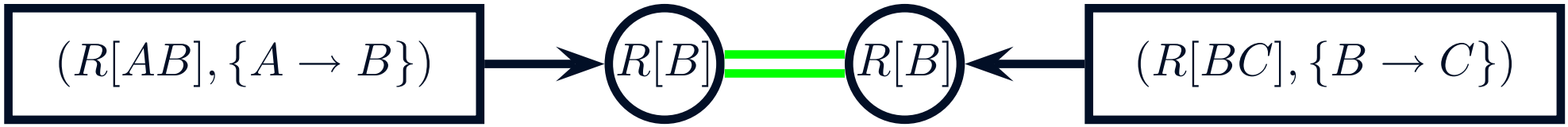

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- This recaptures lossless and dependency-preserving decomposition, but as a *composition* rather than as a decomposition.

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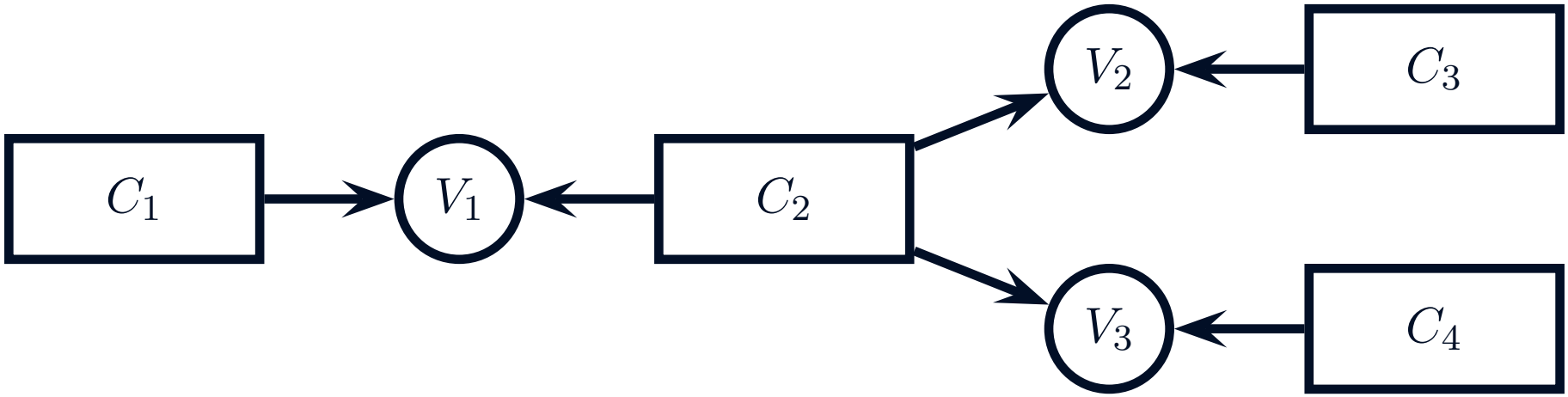

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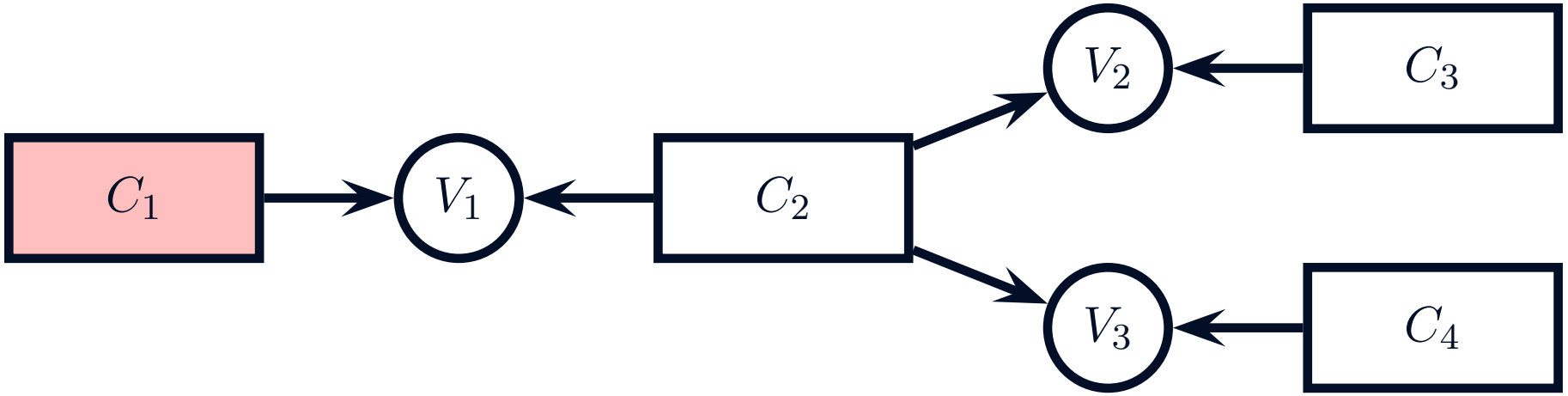

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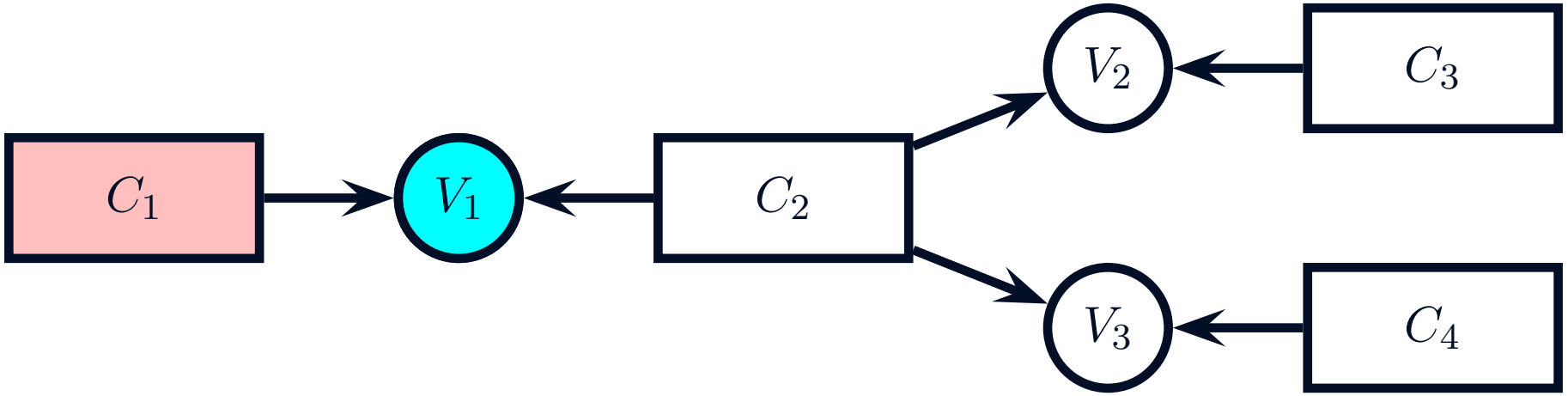

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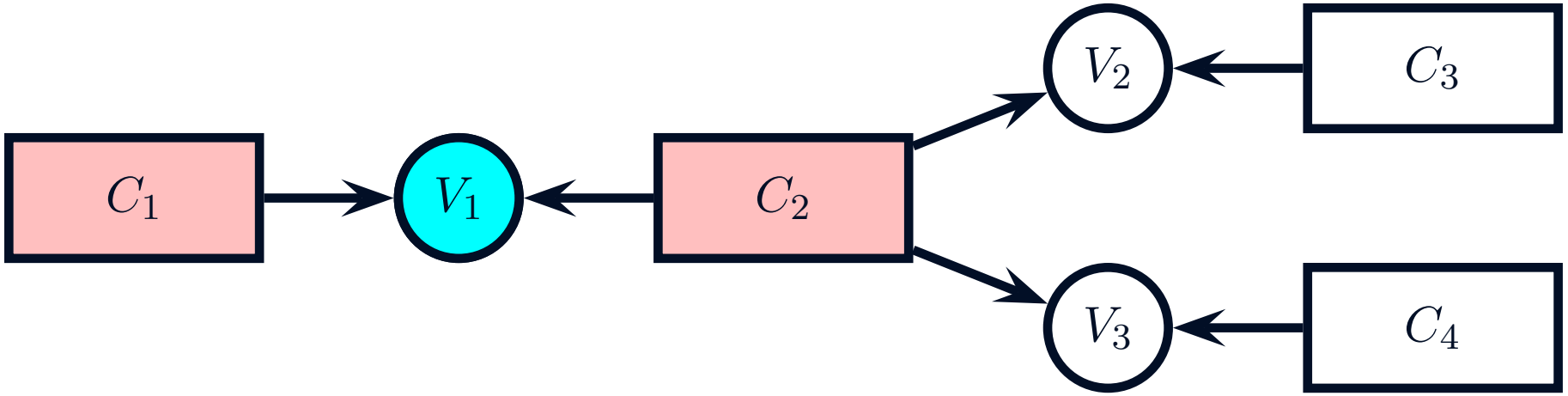

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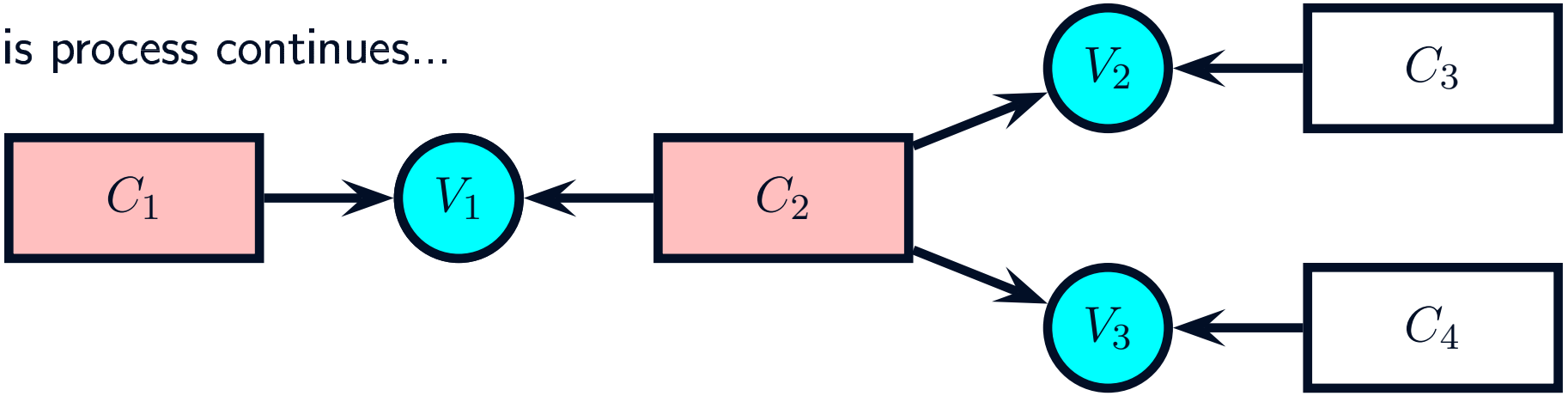

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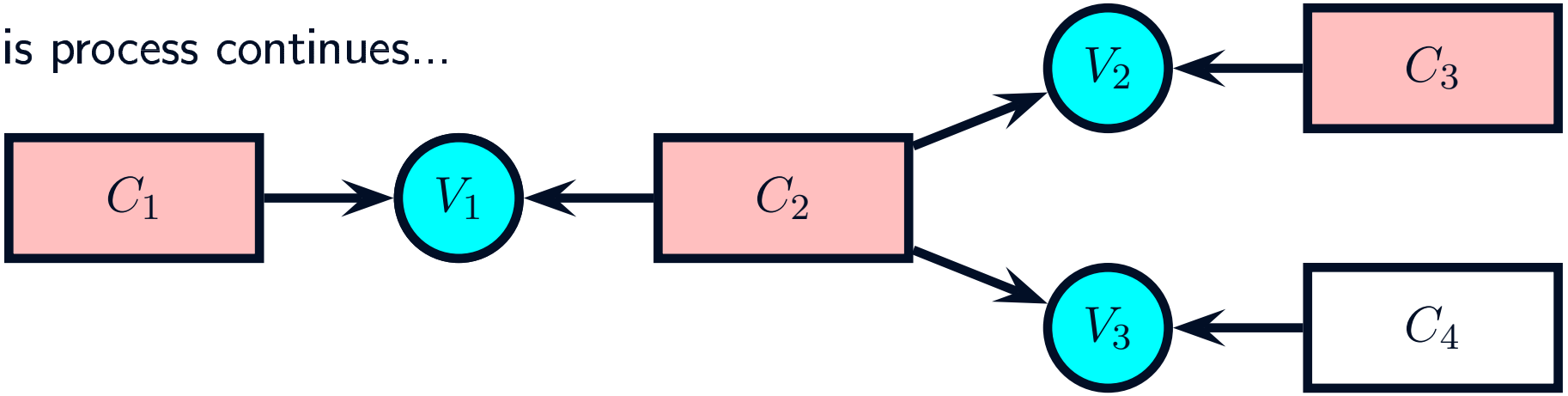

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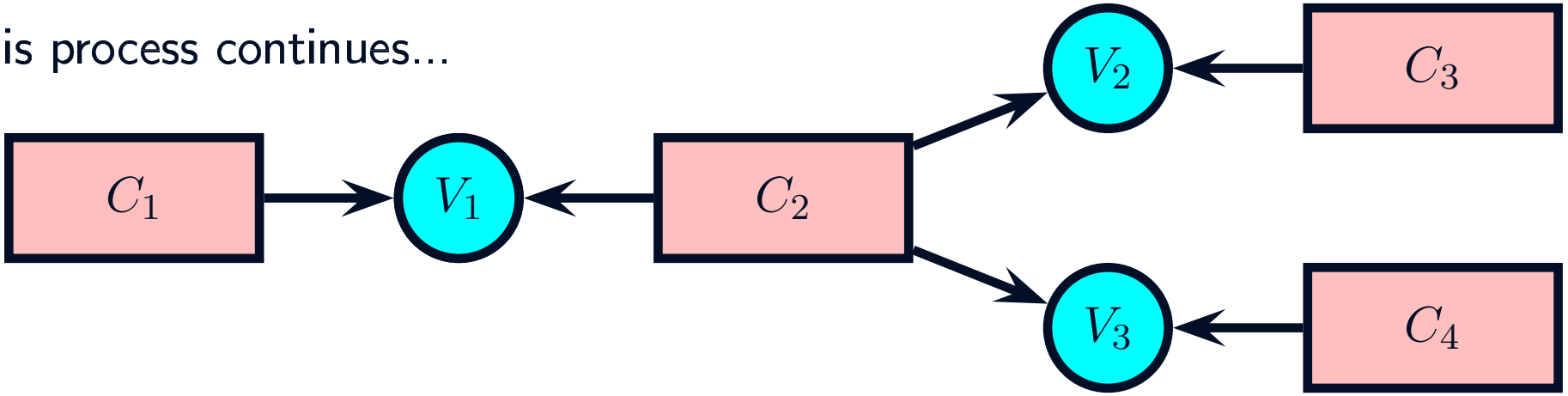

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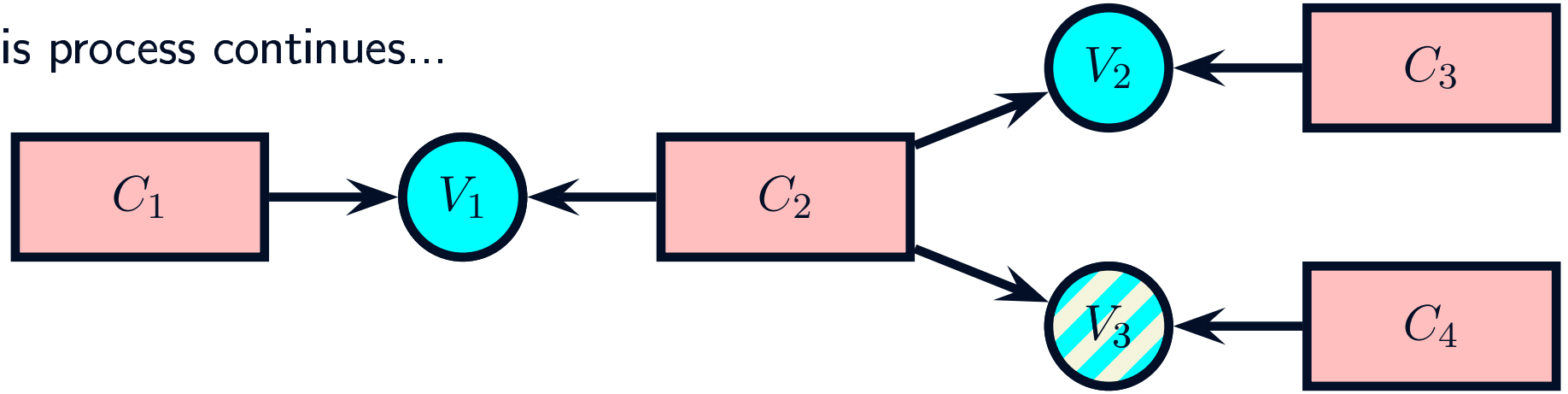

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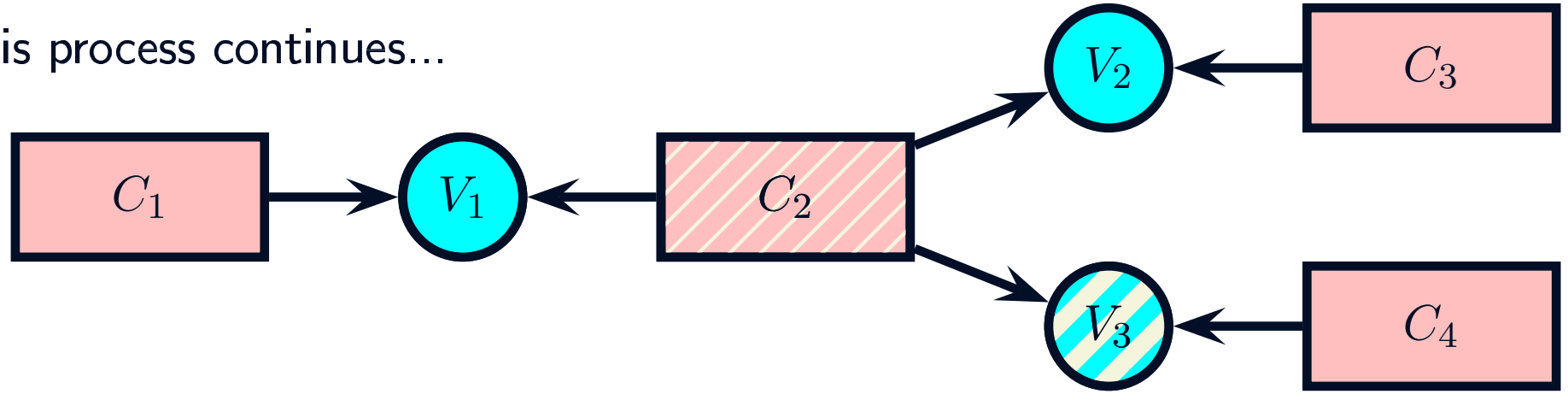

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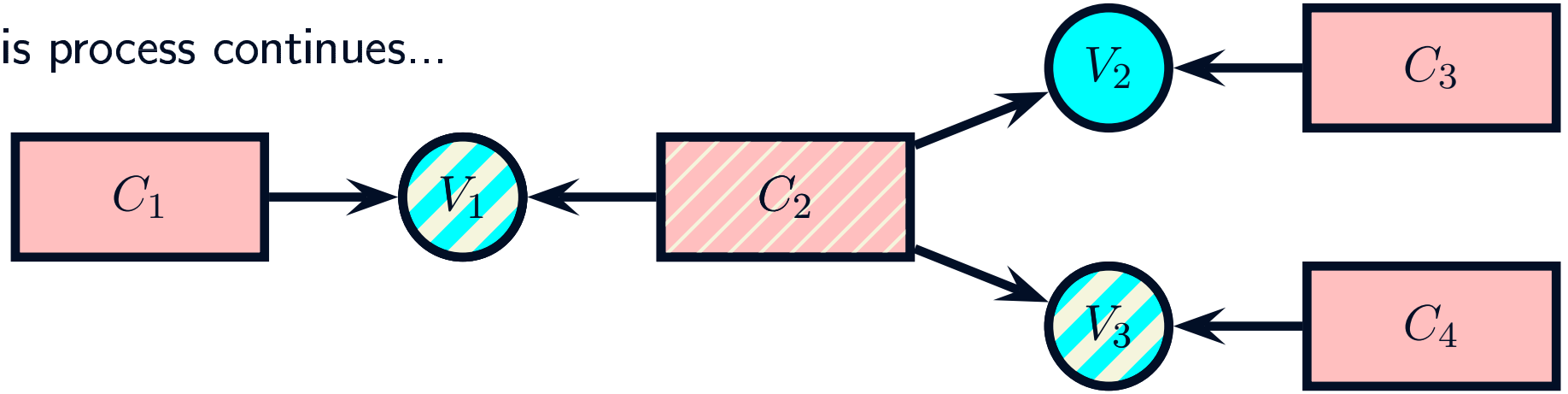

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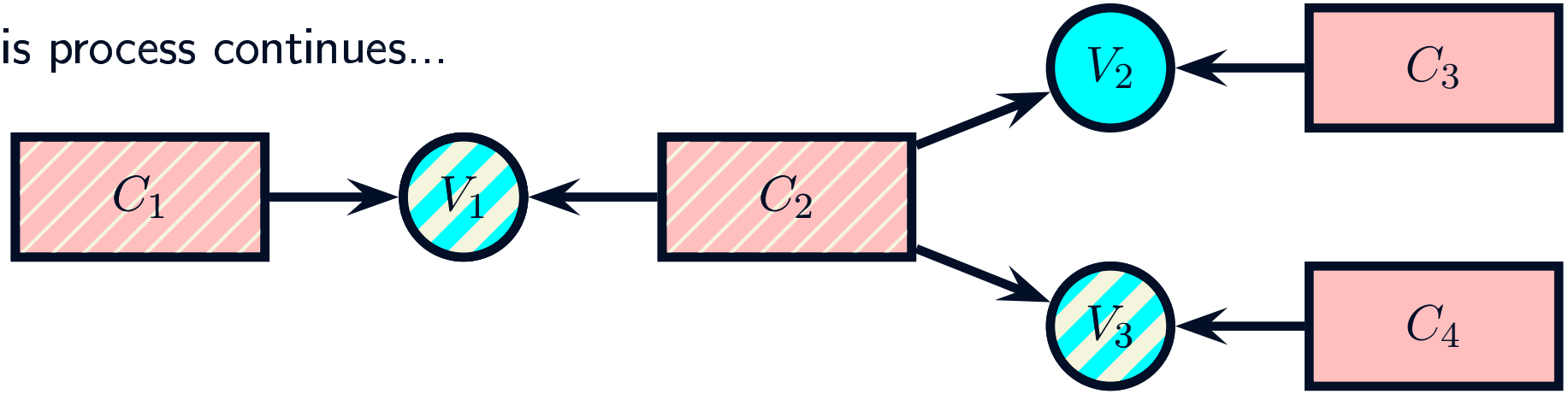

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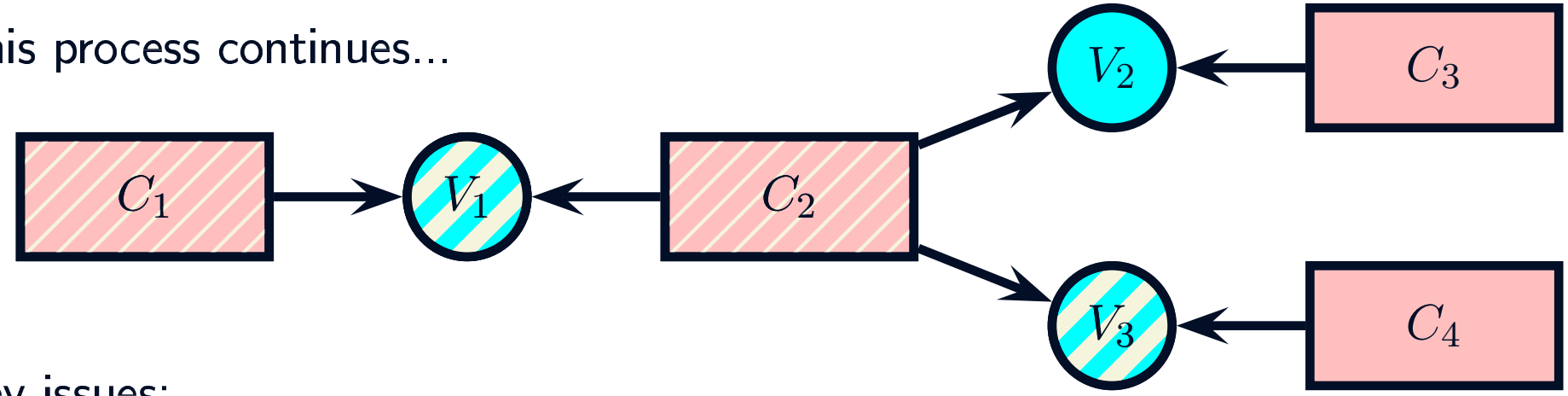


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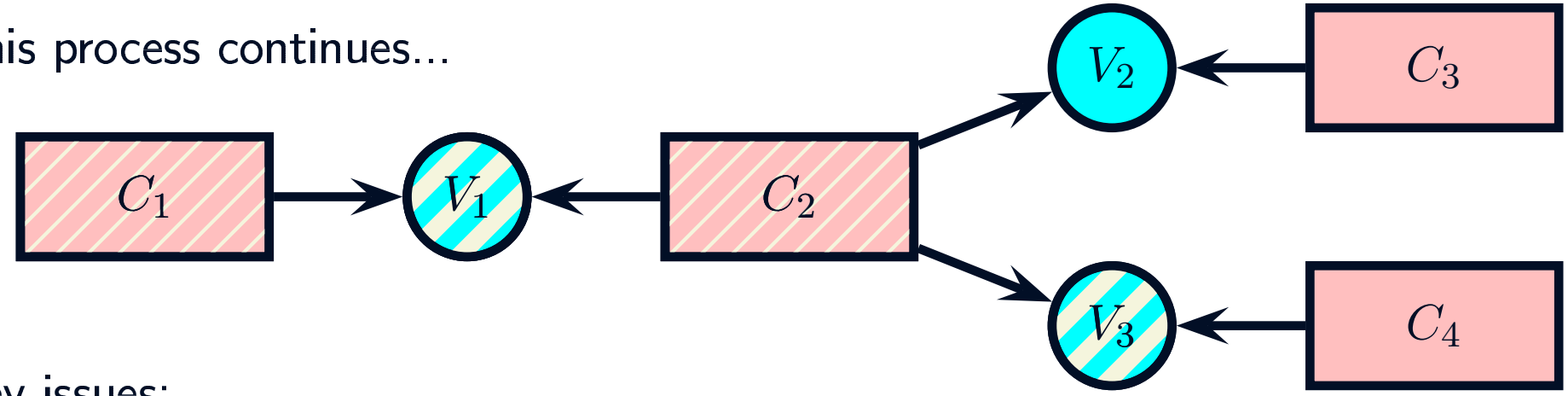


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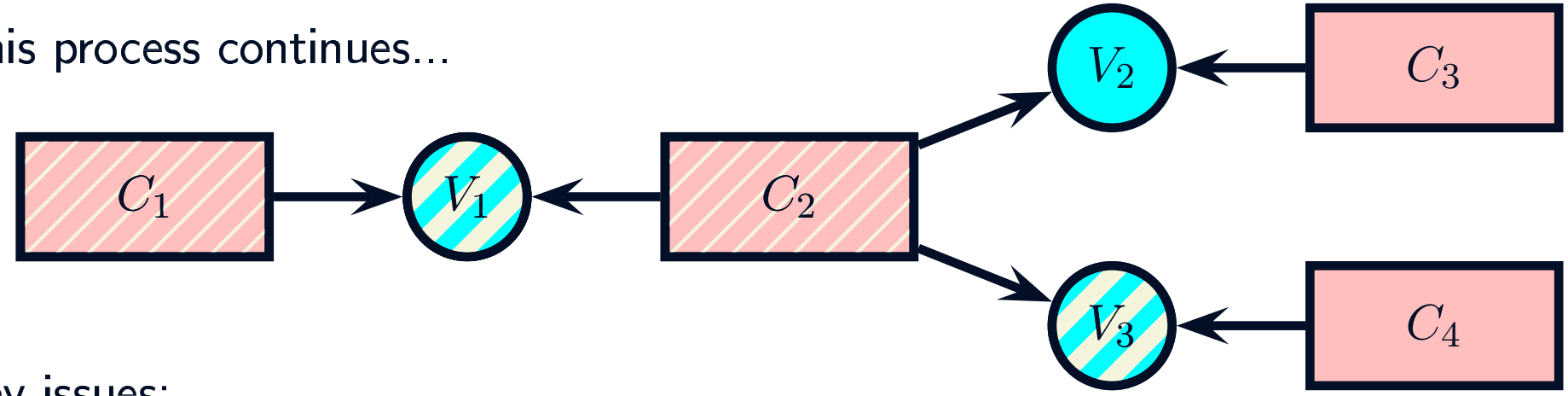


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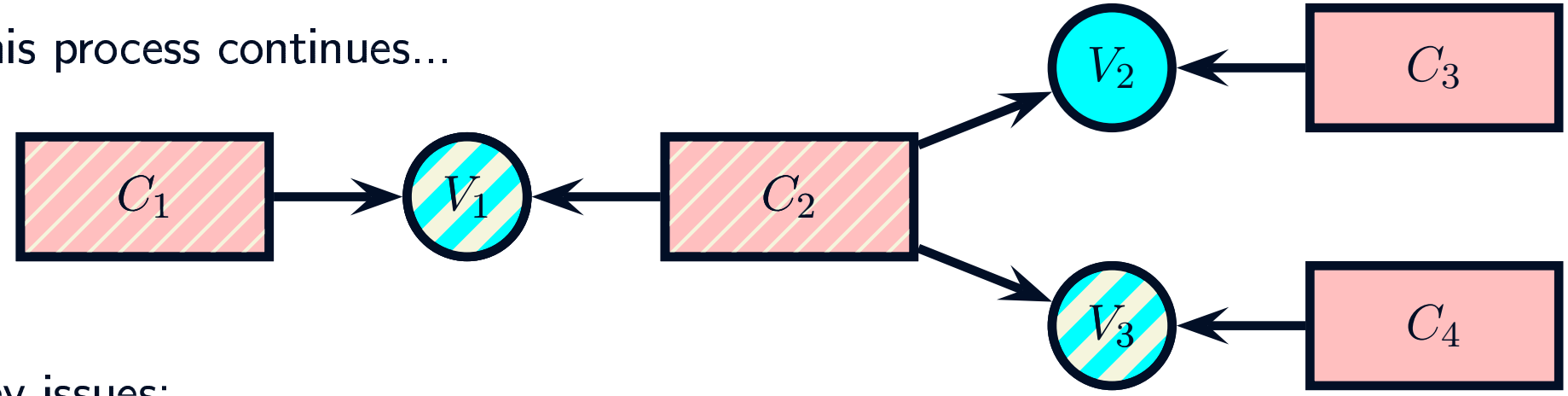


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- An architecture for the support of such *cooperative updates* is needed.

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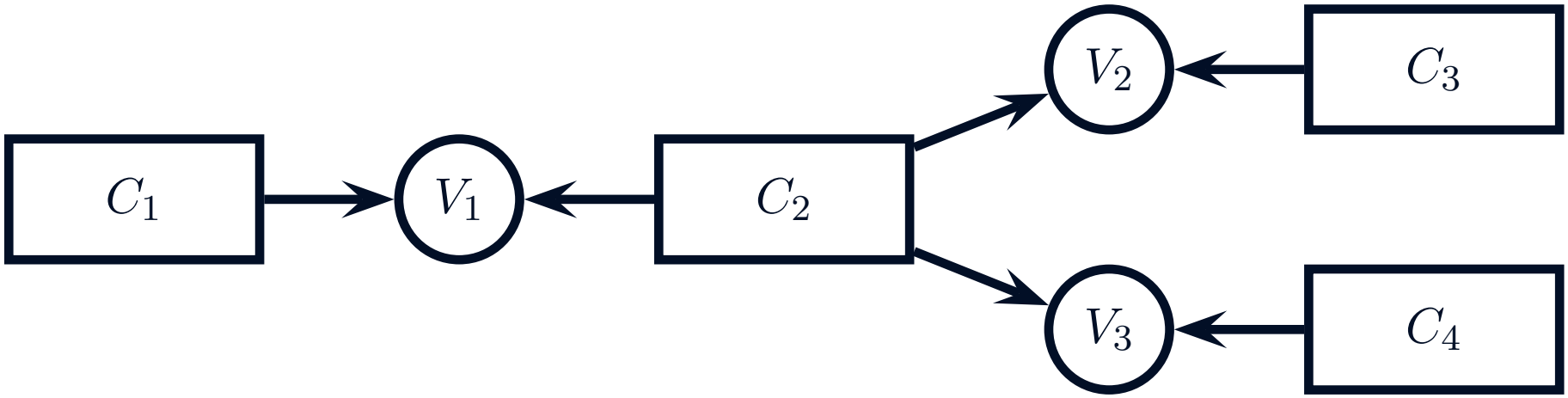

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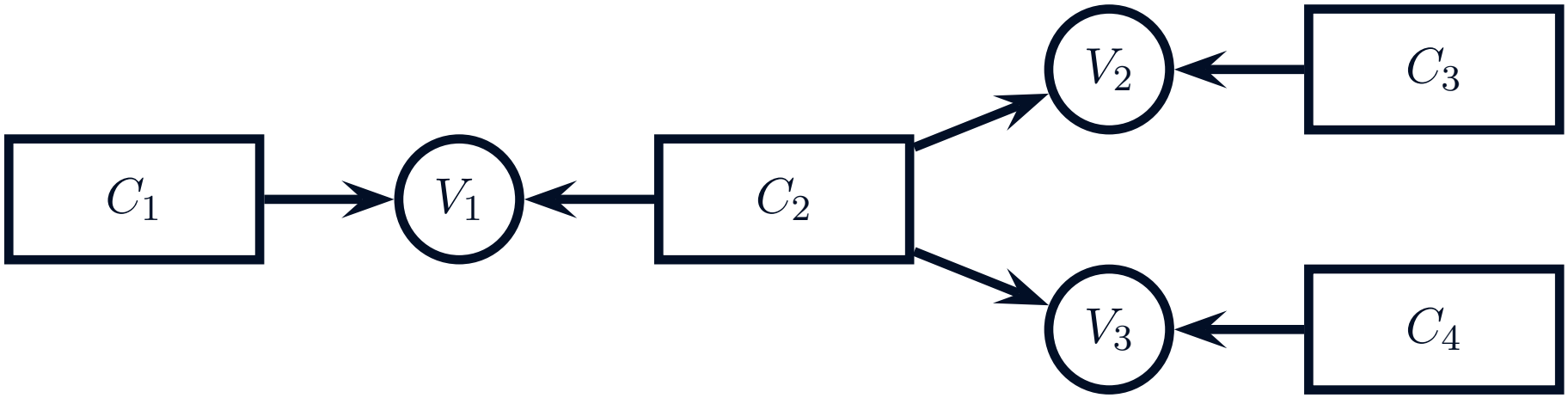


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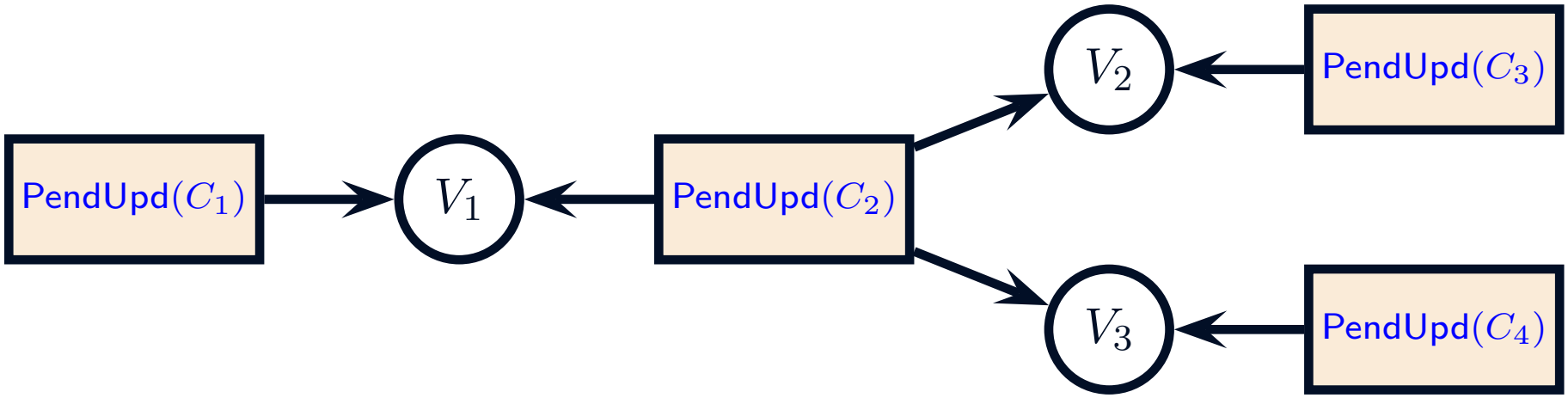


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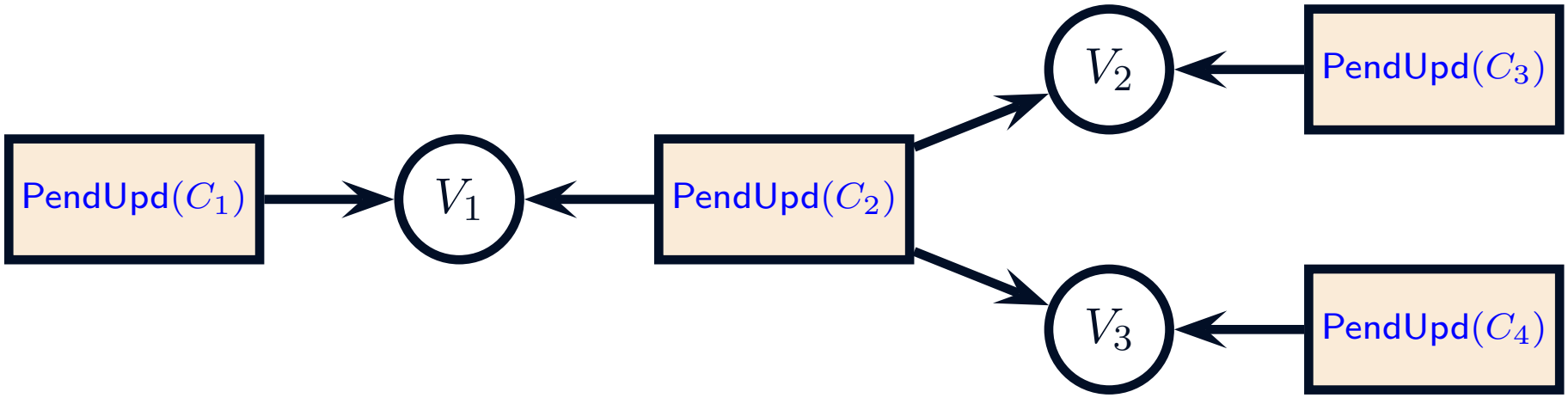


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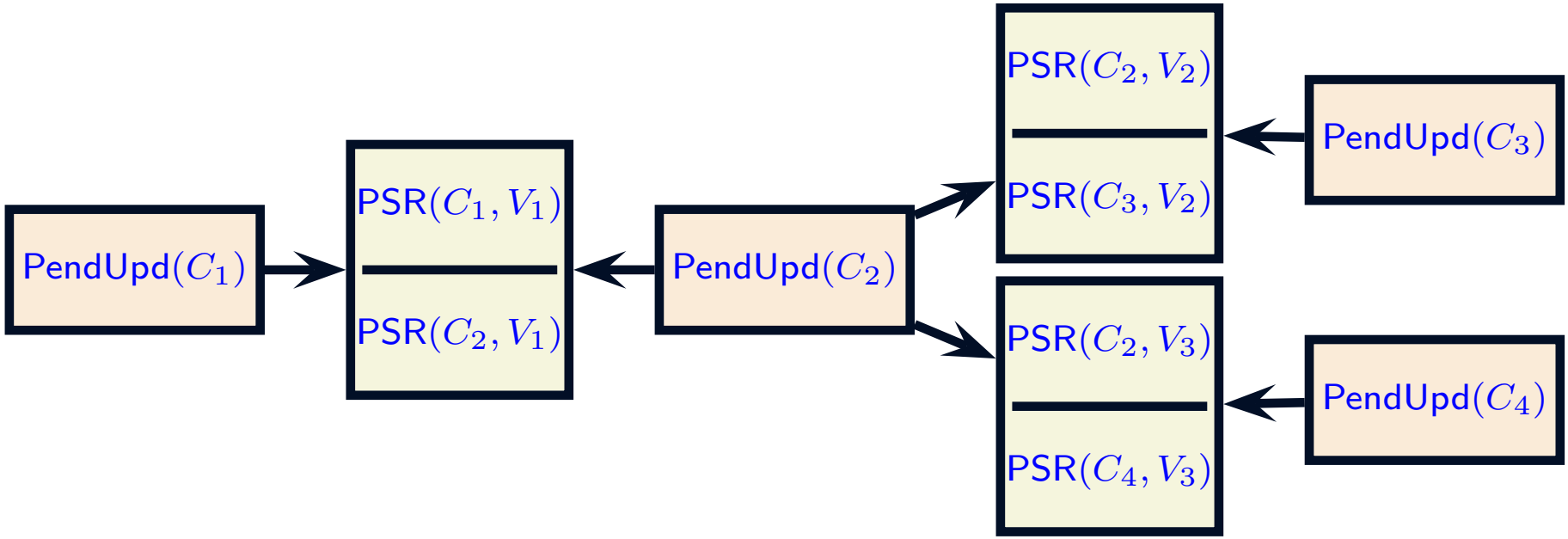


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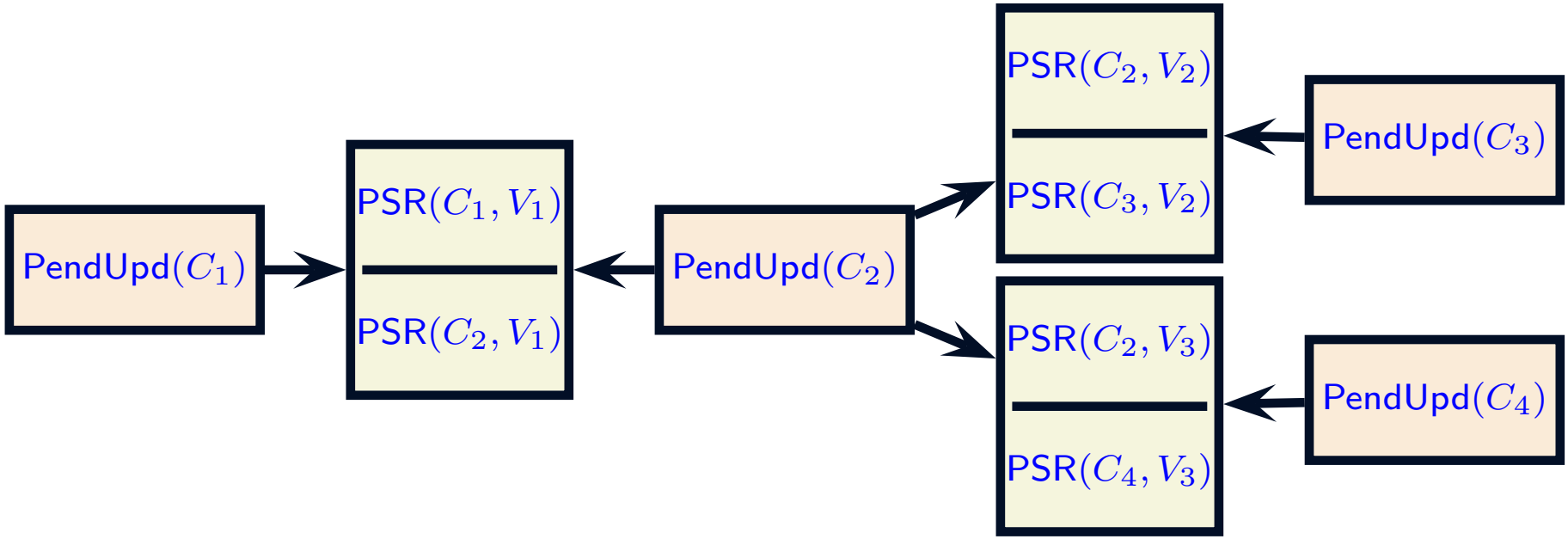


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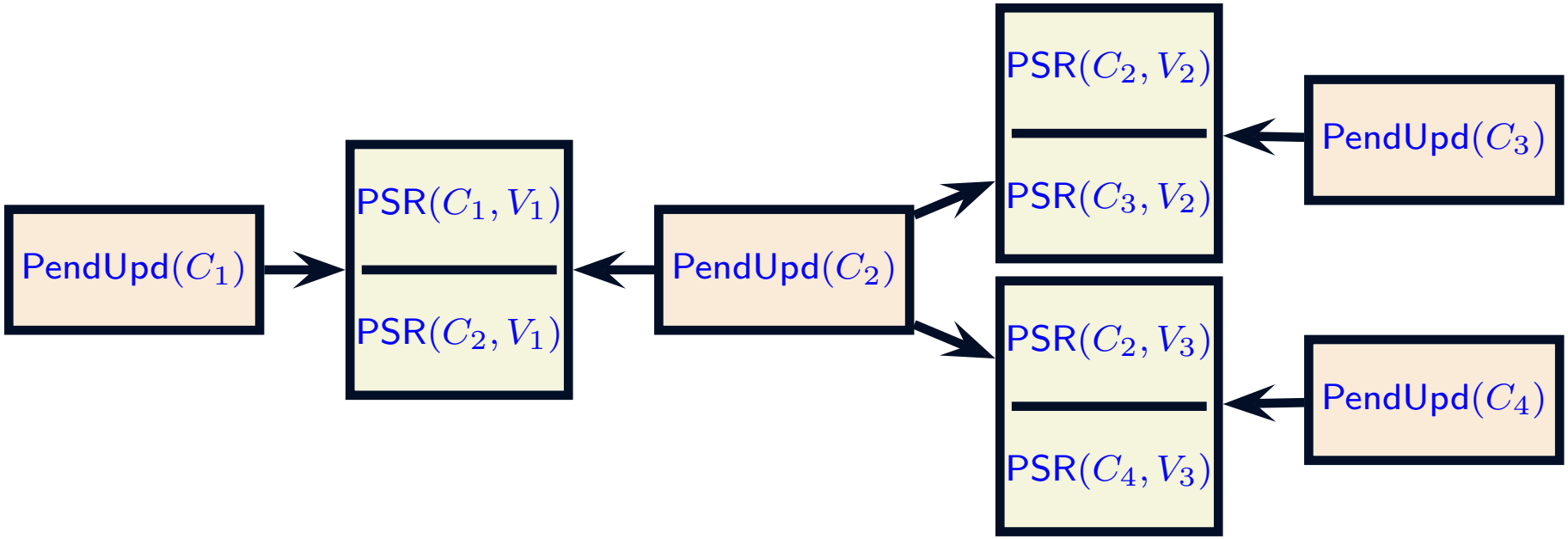
- To each view schema $V_i$ is associated a *port status register* PSR($C_j, V_i$) for each component schema $C_j$ which is connected to it.
- These additional registers are part of the control structure, and are in addition to the database itself.

# Operation of Cooperative Update Management

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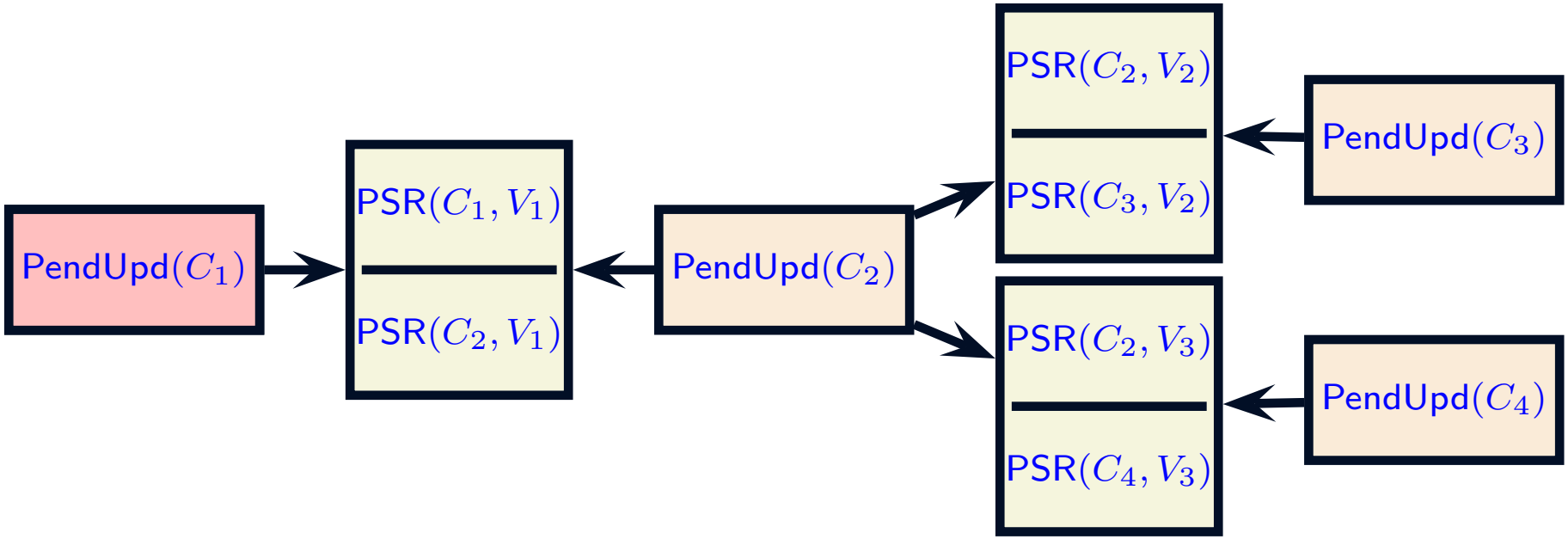
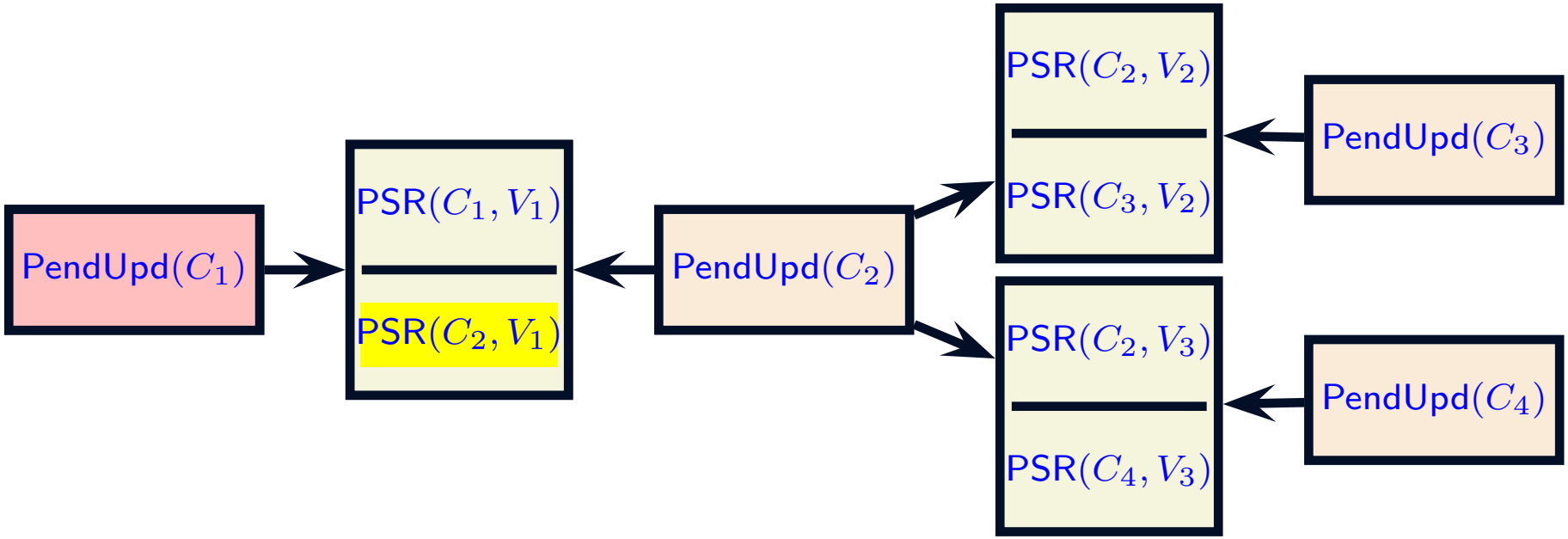
# Operation of Cooperative Update Management



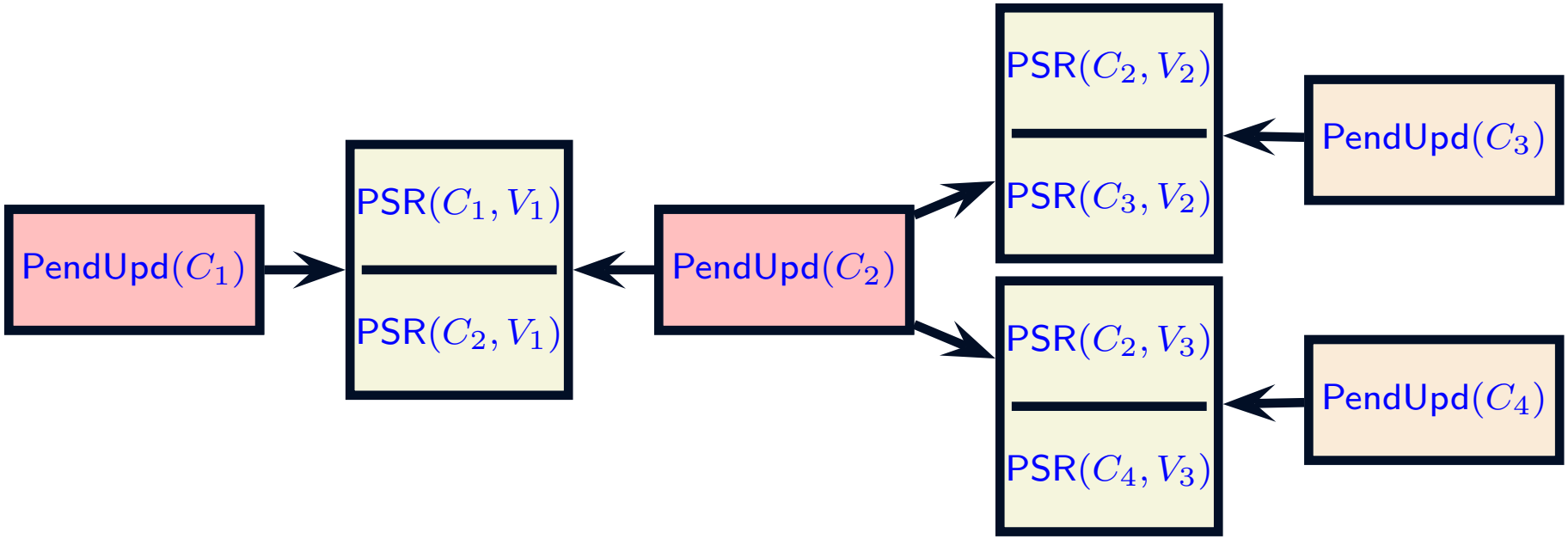

- All port status registers are initially null.
- An update to a component schema

# Operation of Cooperative Update Management




- All port status registers are initially null.
- An update to a component schema places the corresponding projection into the port status registers of its neighbors.

# Operation of Cooperative Update Management




- All port status registers are initially null.
- An update to a component schema places the corresponding projection into the port status registers of its neighbors.
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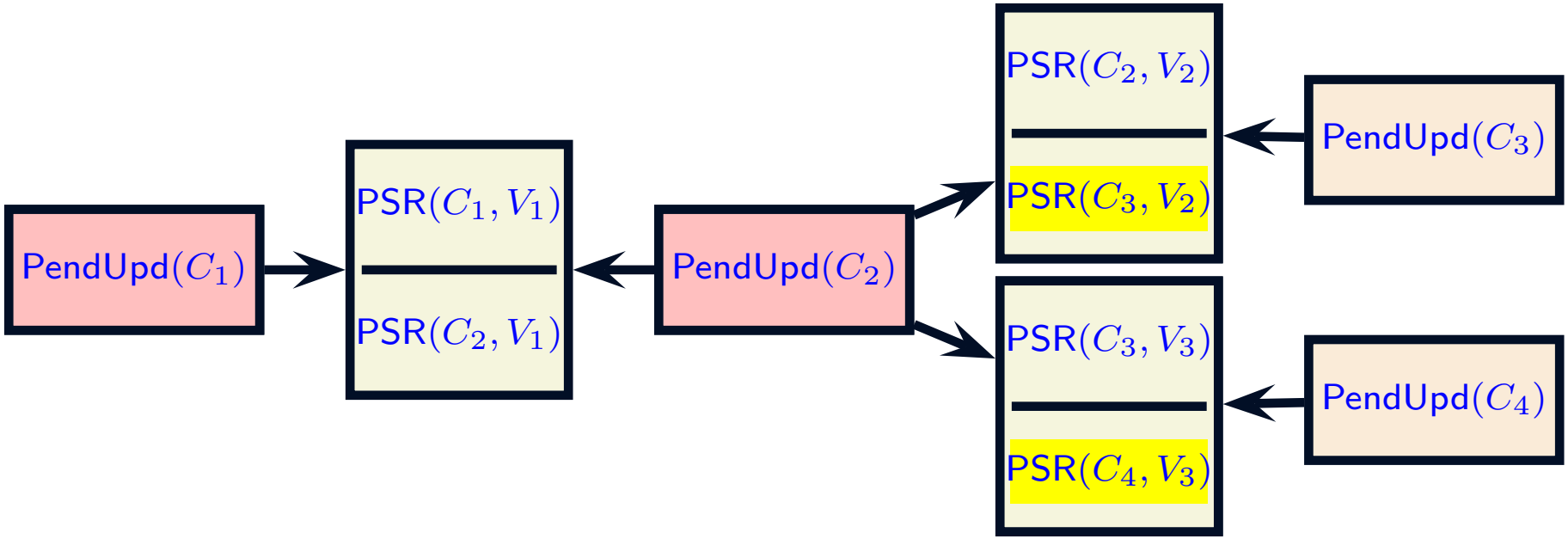
# Operation of Cooperative Update Management

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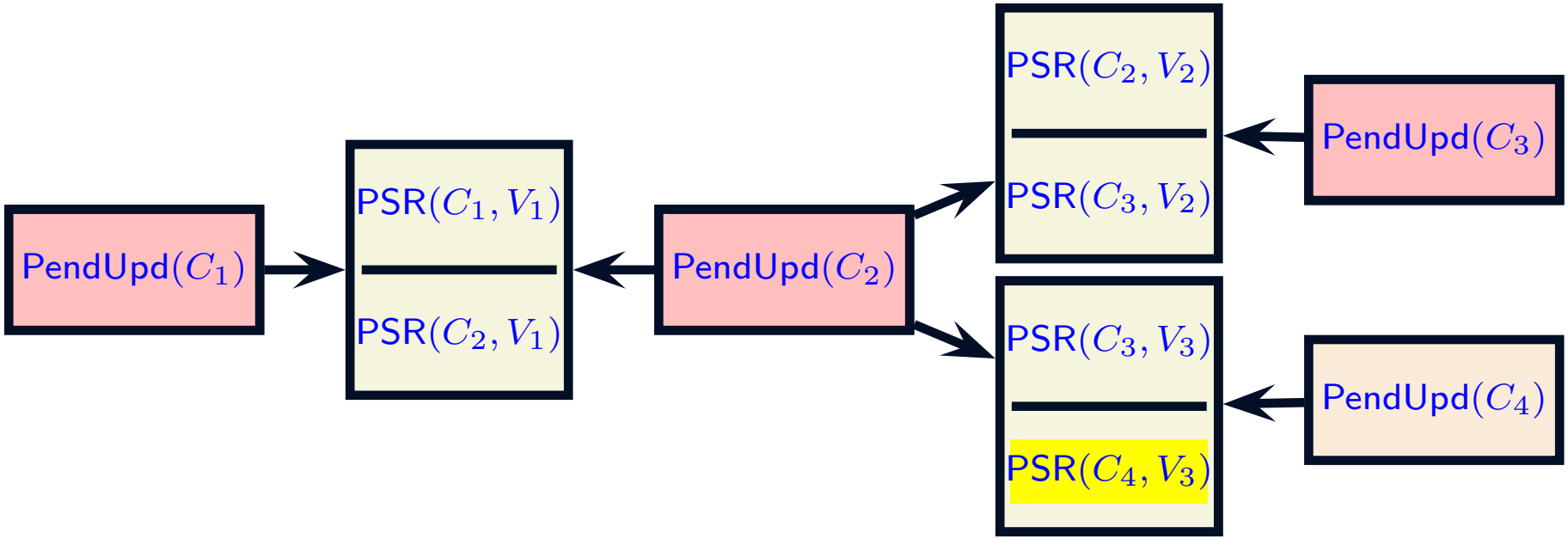
- The process repeats, and is nondeterministic.

# Operation of Cooperative Update Management

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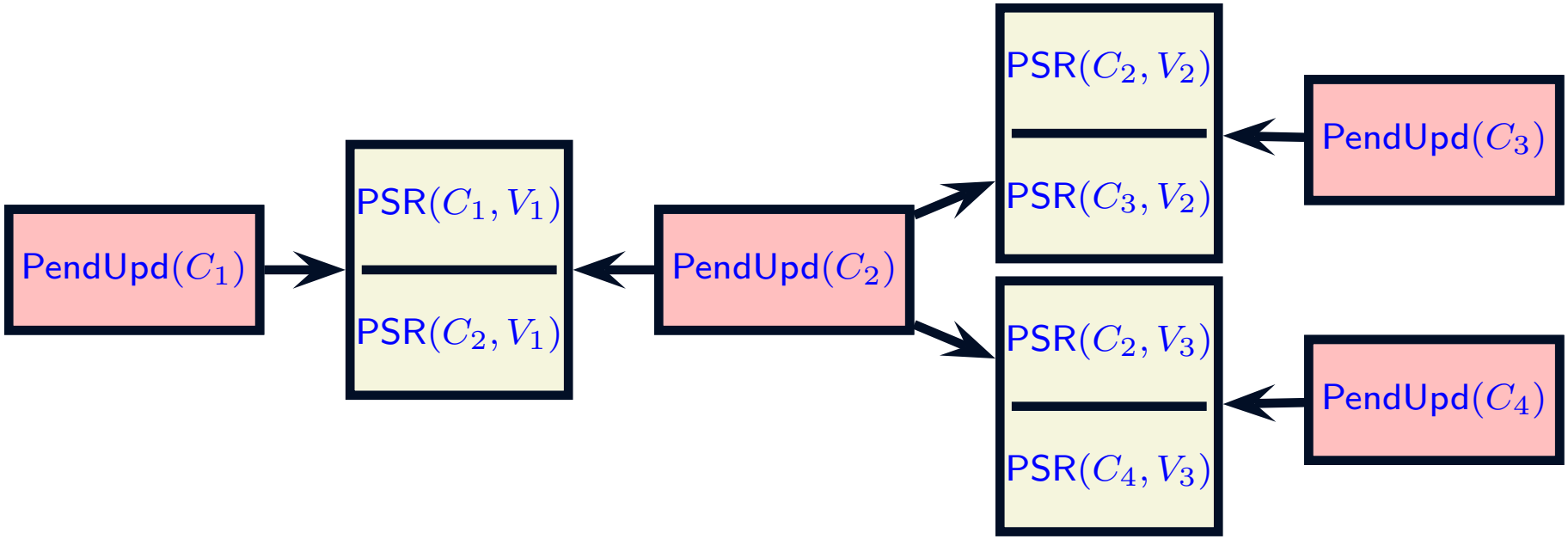


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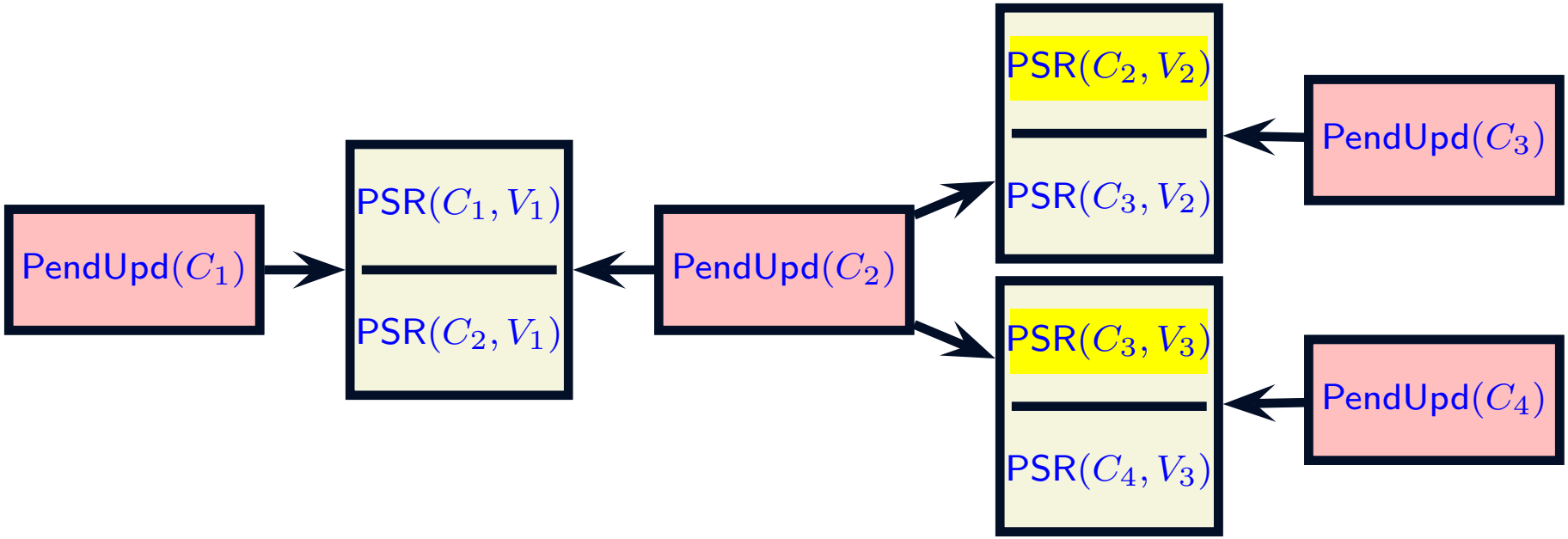


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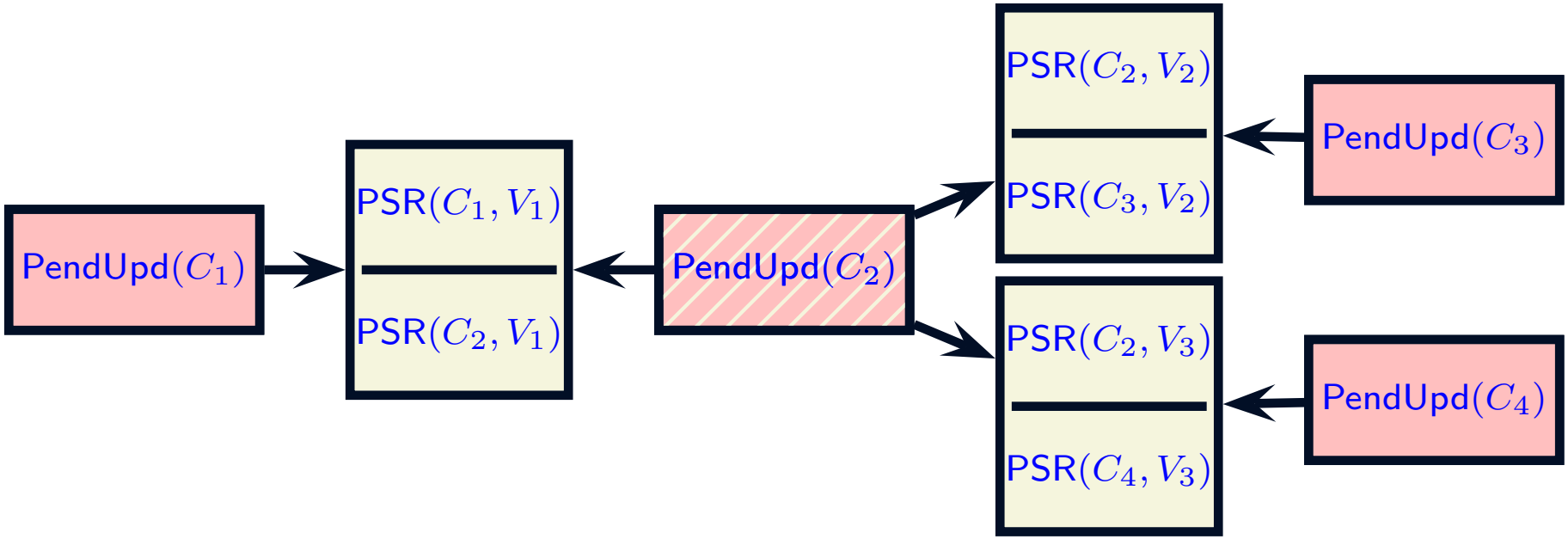


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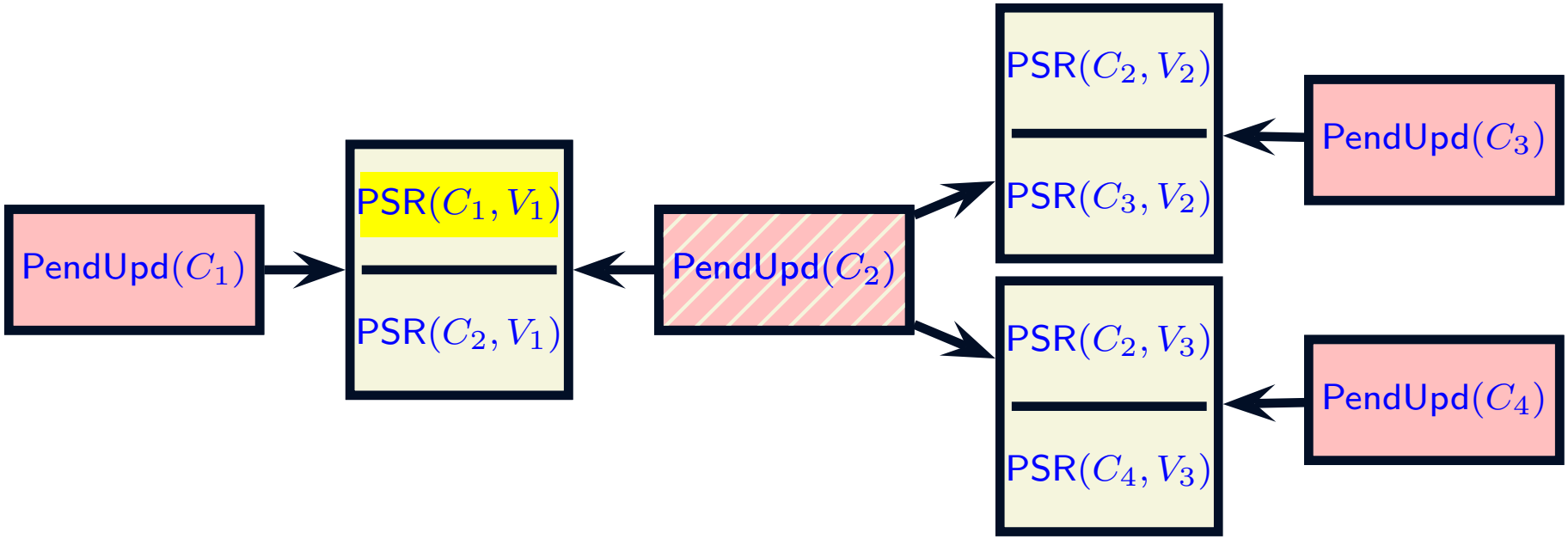


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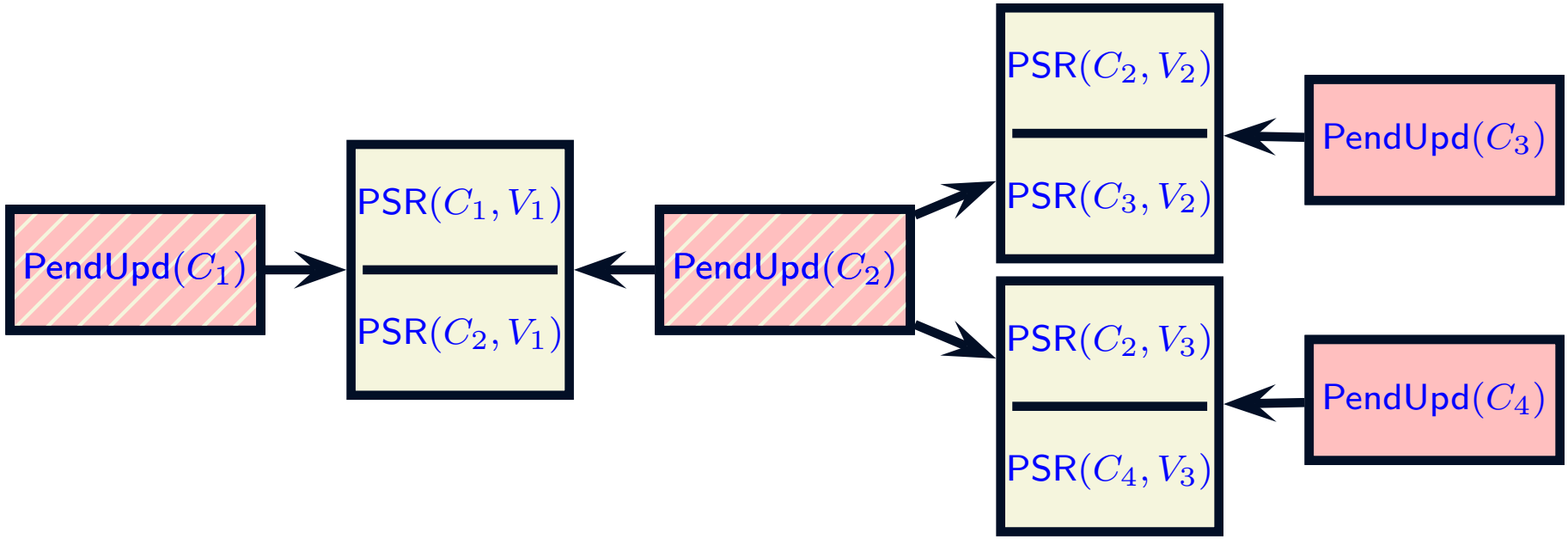


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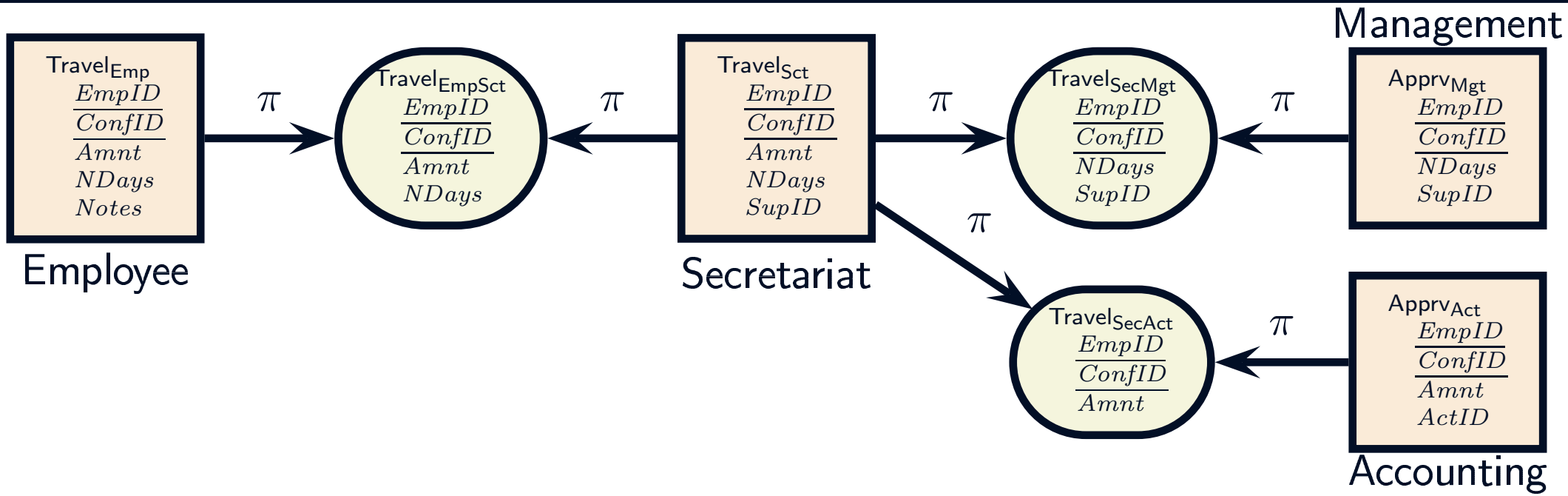
# Example: Travel Request and Authorization



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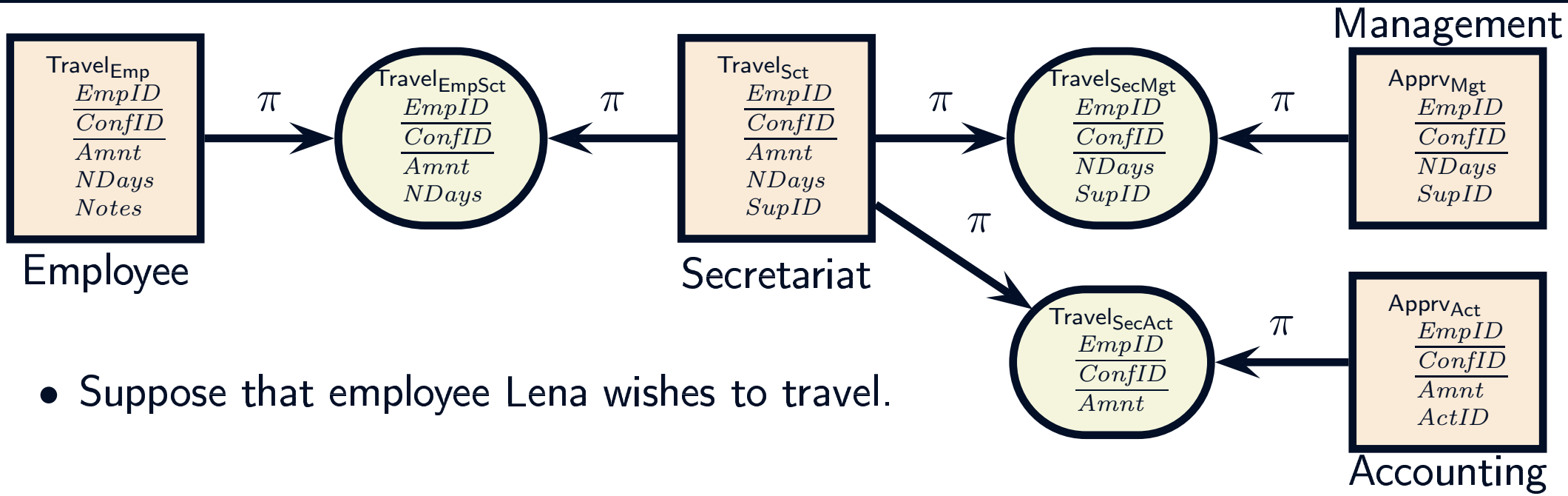
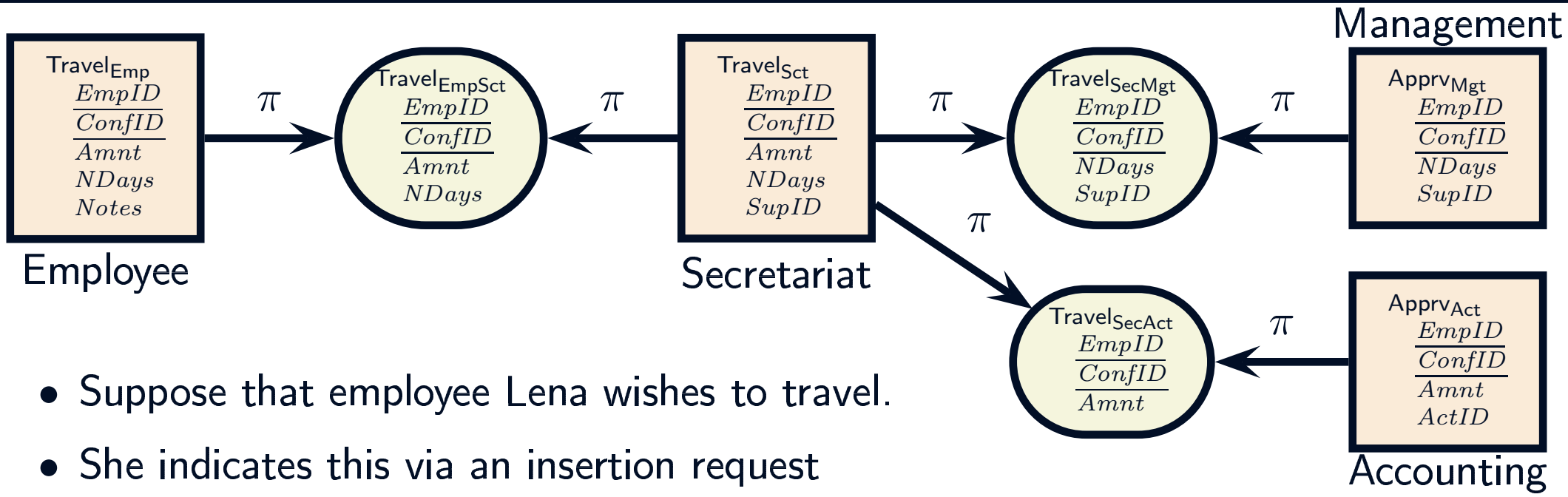


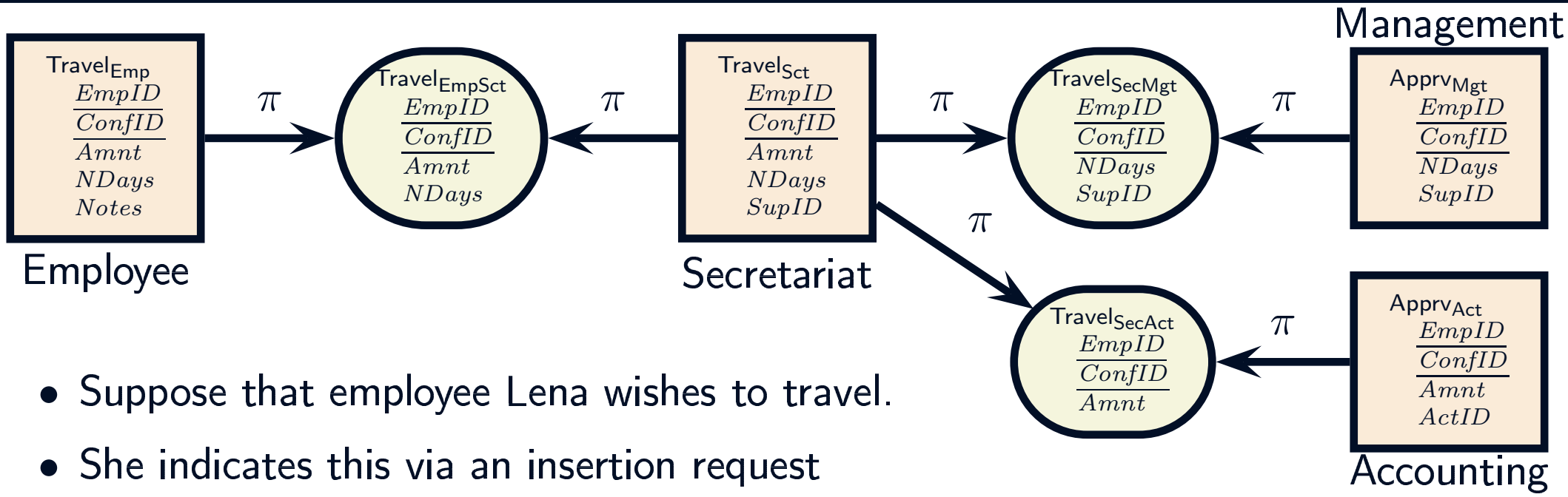

- Suppose that employee Lena wishes to travel.

# Example: Travel Request and Authorization



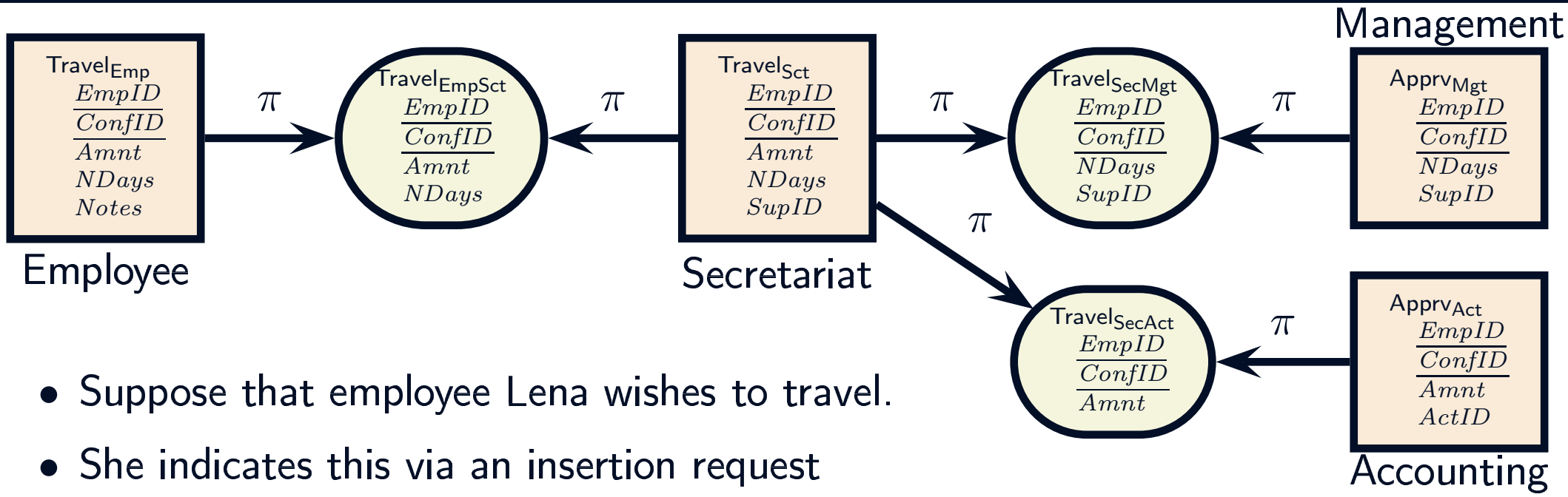

- Suppose that employee Lena wishes to travel.
- She indicates this via an insertion request into the schema of component Employee.

# Example: Travel Request and Authorization




- Suppose that employee Lena wishes to travel.
- She indicates this via an insertion request into the schema of component Employee.
- Such a request is typically in the form of a finite *ranked set* of alternatives.

# Example: Travel Request and Authorization




- Suppose that employee Lena wishes to travel.
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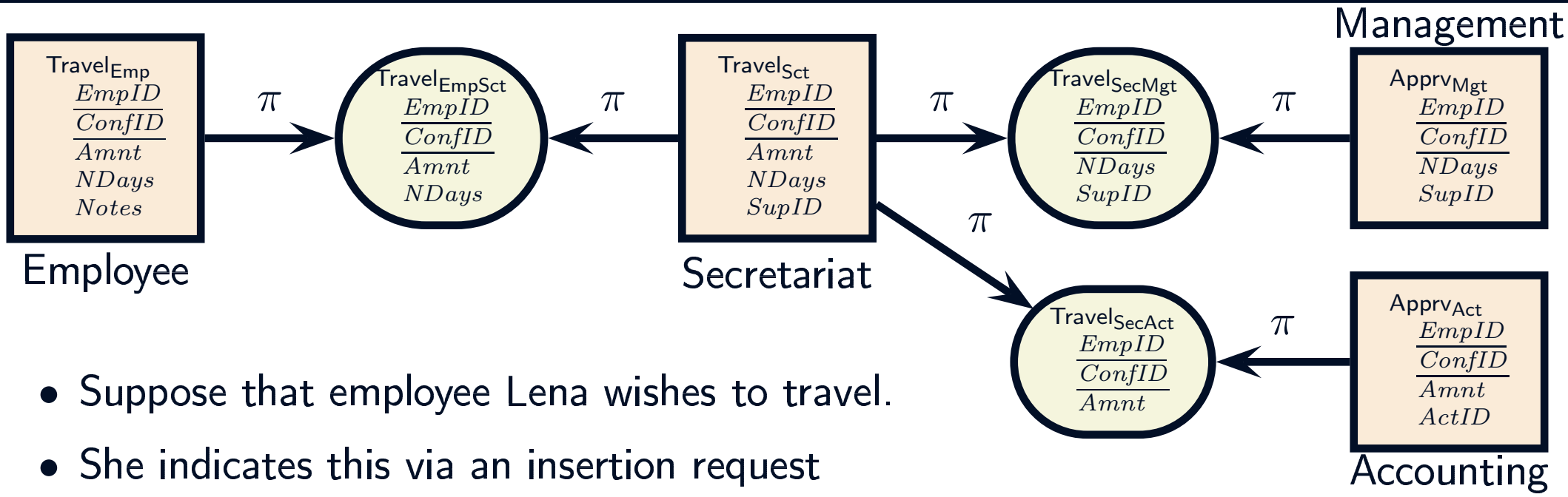
- Such a request is typically in the form of a finite *ranked set* of alternatives.

$$\{\mathsf{Travel}_{\mathsf{Emp}}[\mathsf{Lena}, \mathsf{ADBIS}, e_A, d_A, \mathfrak{n}] \mid €800 \leq e_A \leq €2000,\ 5 \leq d_A \leq 10\} \cup$$
$$\{\mathsf{Travel}_{\mathsf{Emp}}[\mathsf{Lena}, \mathsf{DEXA}, e_D, d_D, \mathfrak{n}] \mid €1000 \leq e_D \leq €2000,\ 3 \leq d_D \leq 10\}$$

# Example: Travel Request and Authorization

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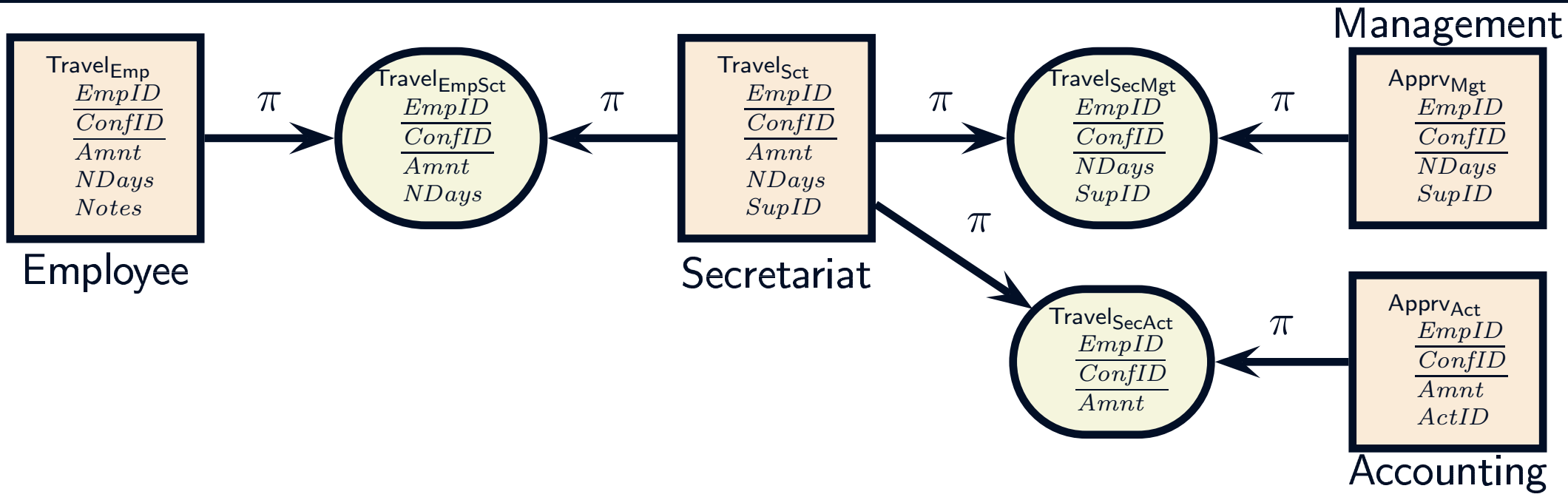
$$\{\mathsf{Travel}_{\mathsf{Emp}}[\mathsf{Lena}, \mathsf{DEXA}, e_D, d_D, \mathfrak{n}] \mid €1000 \leq e_D \leq €2000,\ 3 \leq d_D \leq 10\}$$

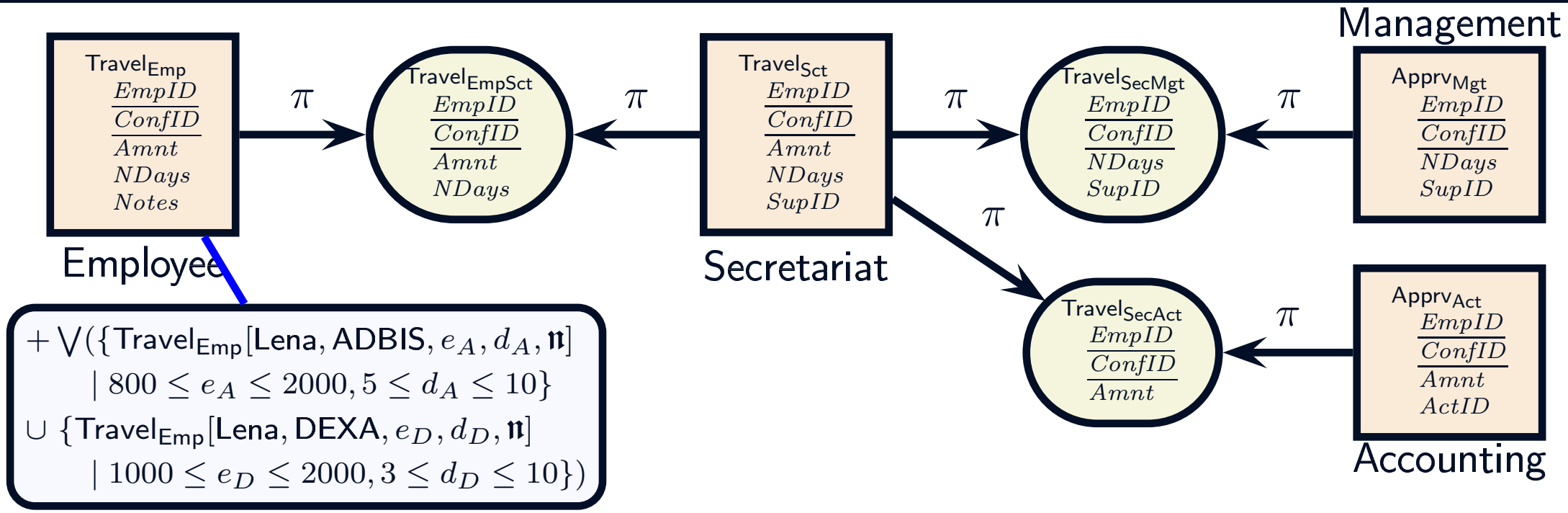
  - ADBIS is always preferred to DEXA.
  - More money and days are always preferred to fewer.

# Example: Evolution of Travel Request and Authorization



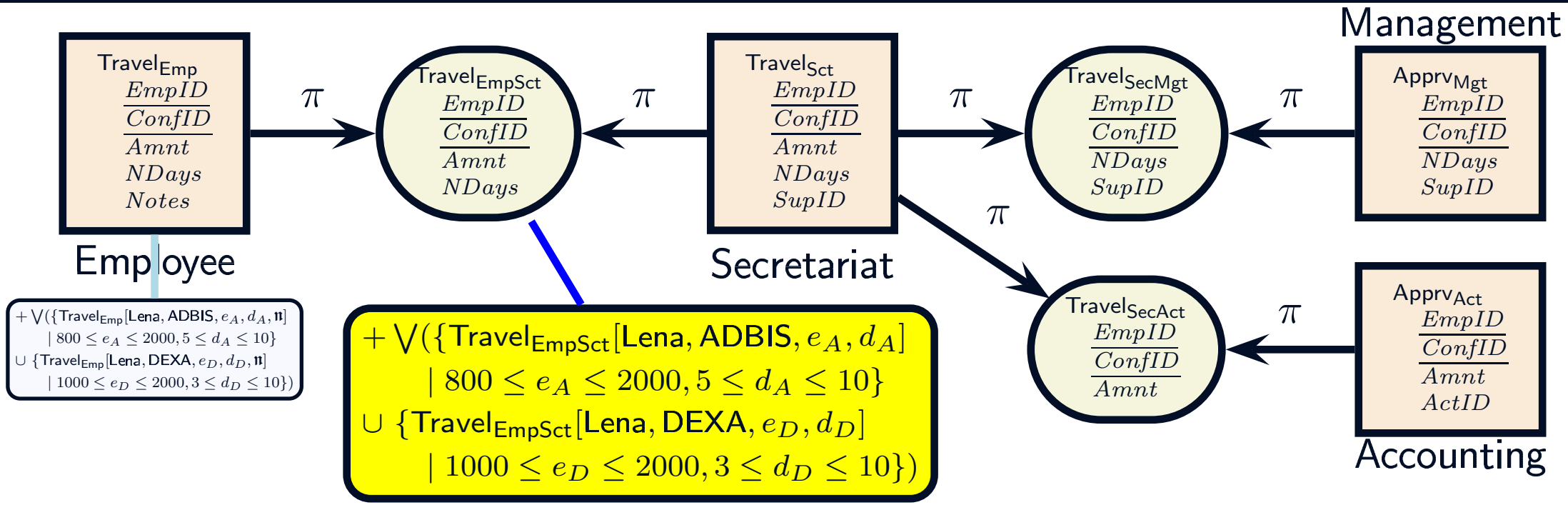

- The evolution of a specific update request will now be illustrated.

# Example: Evolution of Travel Request and Authorization



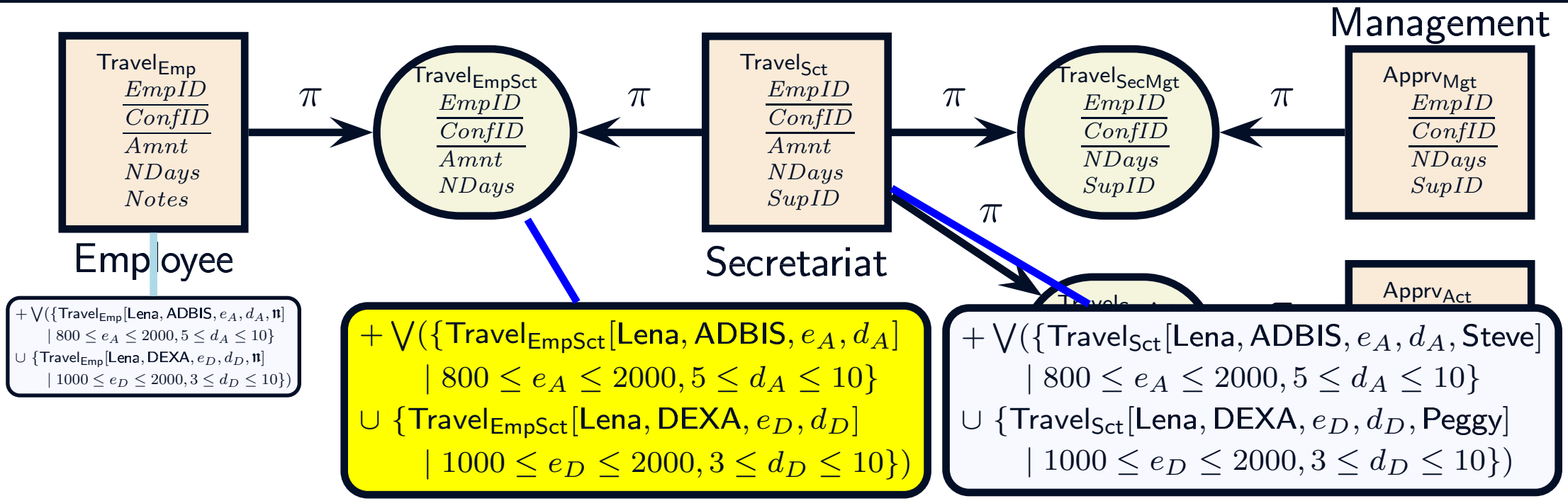

- First, the desired ranked update is entered into the pending update register for Employee. Notation:
  - $+$ = Insert.
  - $\bigvee$ = Choose one of the alternatives.

# Example: Evolution of Travel Request and Authorization



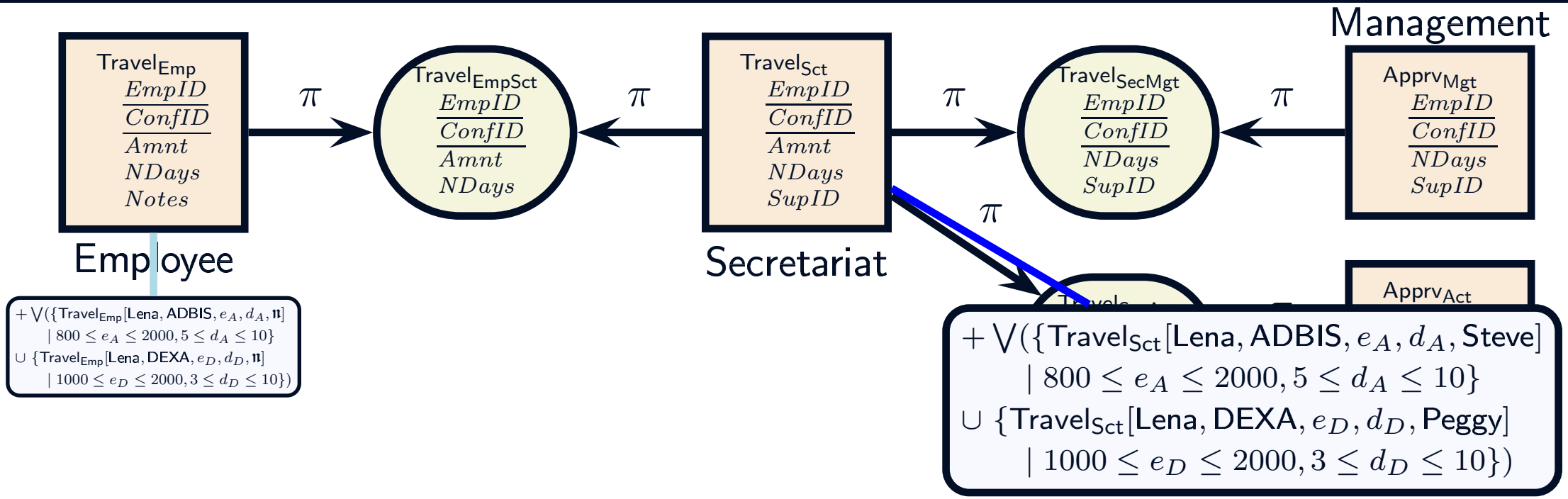

- This update is then projected to the port-status register which connects Employee to Secretariat.

# Example: Evolution of Travel Request and Authorization



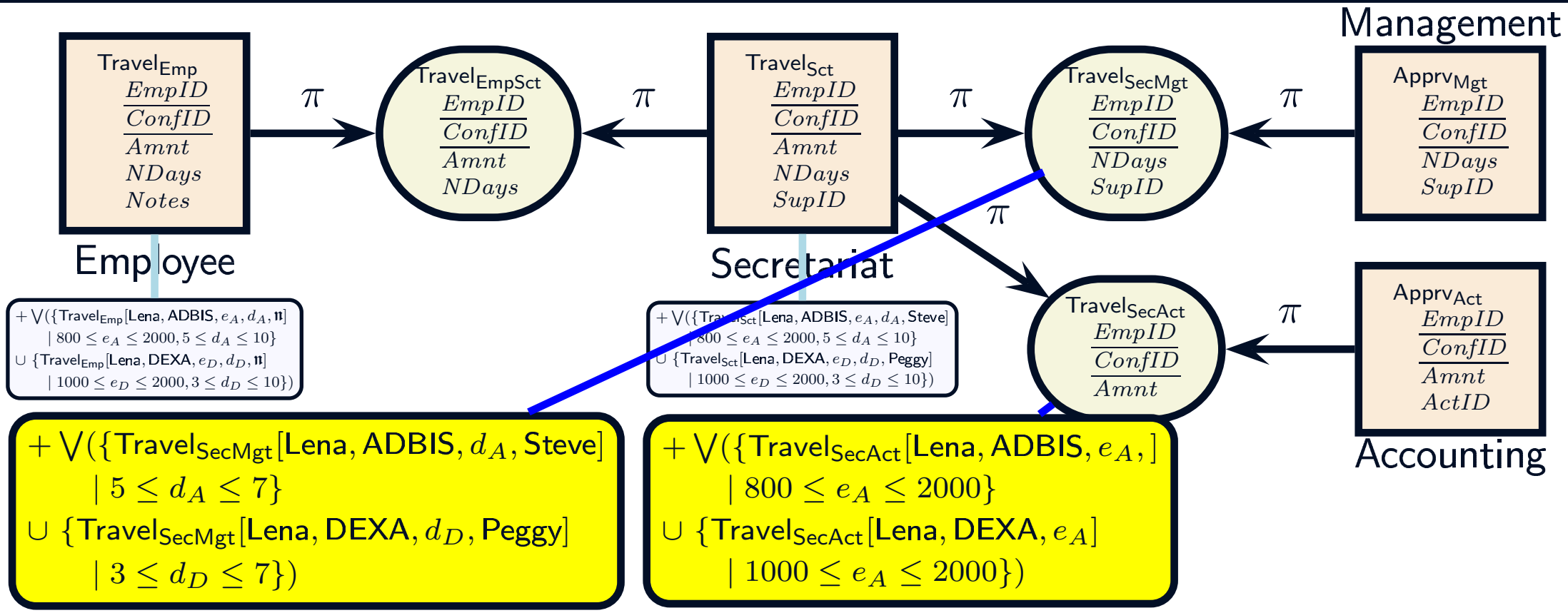

- The user of the Secretariat component then lifts this update to one on that component. It is placed in the pending-update register for that component.
  - Note that decisions must be made.
  - One of many possible liftings must be selected.

# Example: Evolution of Travel Request and Authorization



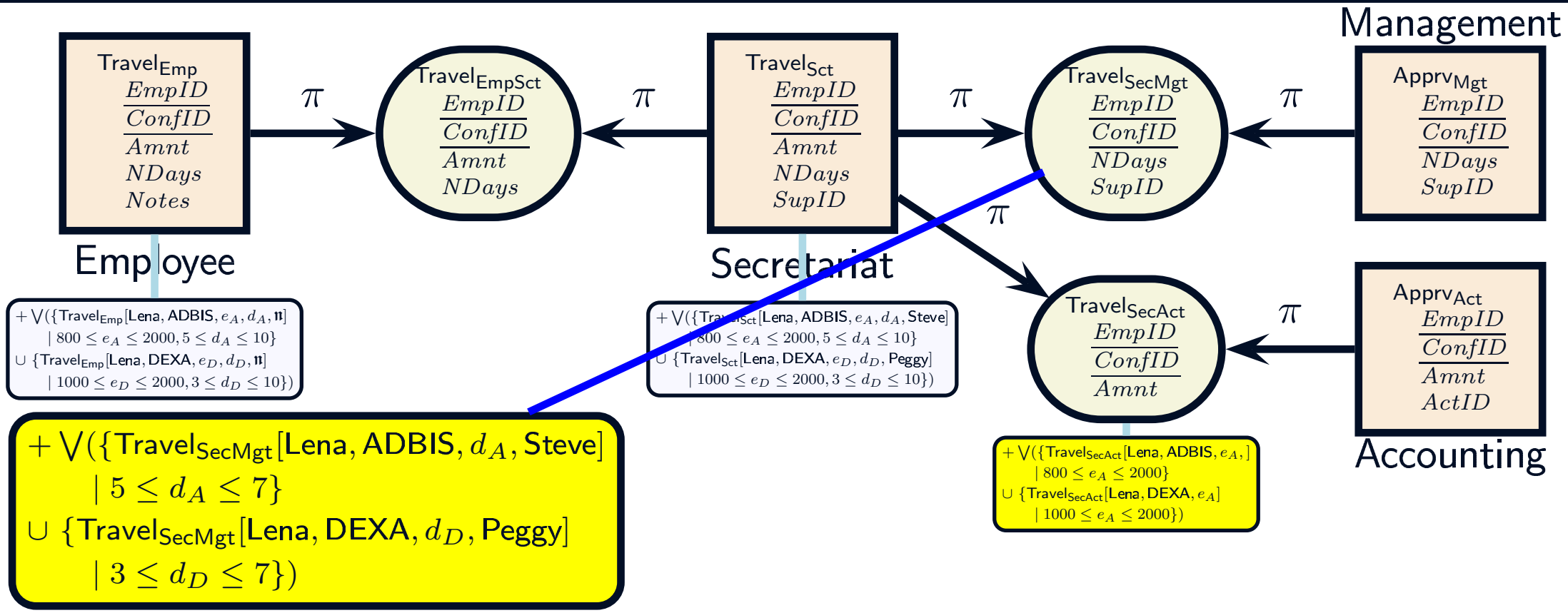

- The port-status register is then cleared, since this update has been processed.

# Example: Evolution of Travel Request and Authorization



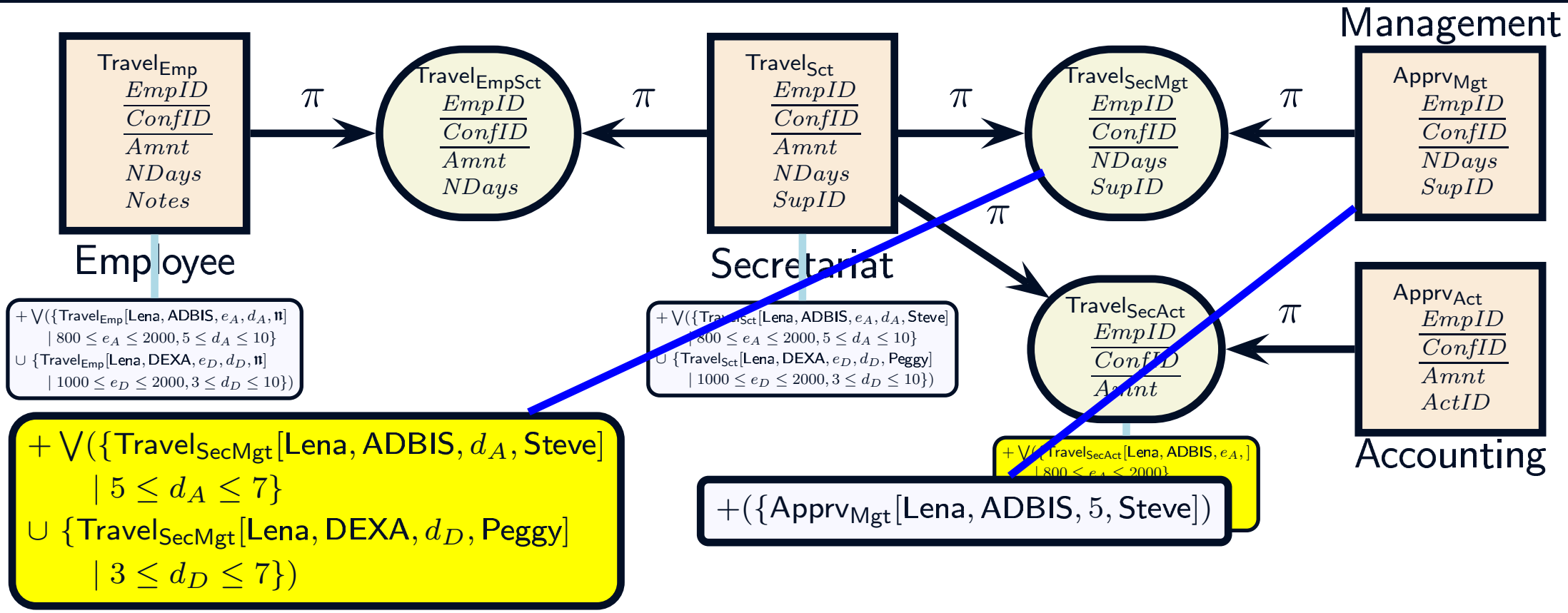

- This lifted update is then projected into the appropriate port-status registers which connect Secretariat to Management and Accounting.
- It is not projected back onto the port-status register which is connected to Employee, because the new value would be the same as the old one.

# Example: Evolution of Travel Request and Authorization



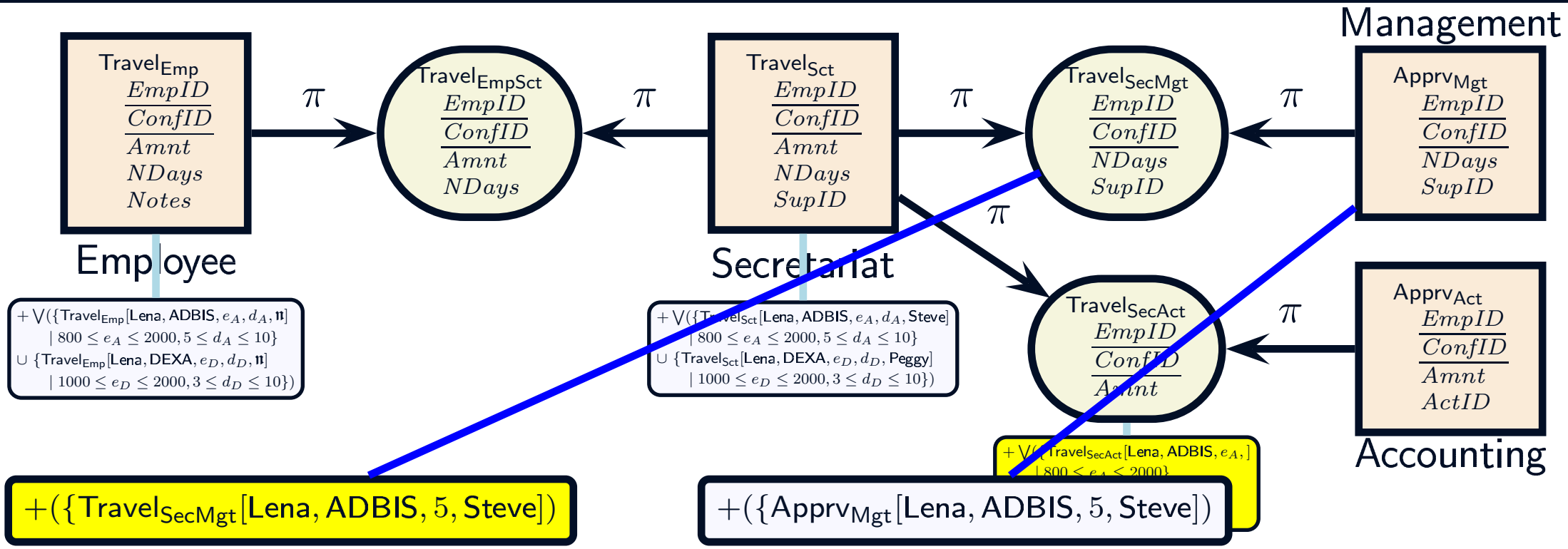

- First consider the problem of lifting the projected update to the Management component.
  - Again, there are decisions to be made.

# Example: Evolution of Travel Request and Authorization



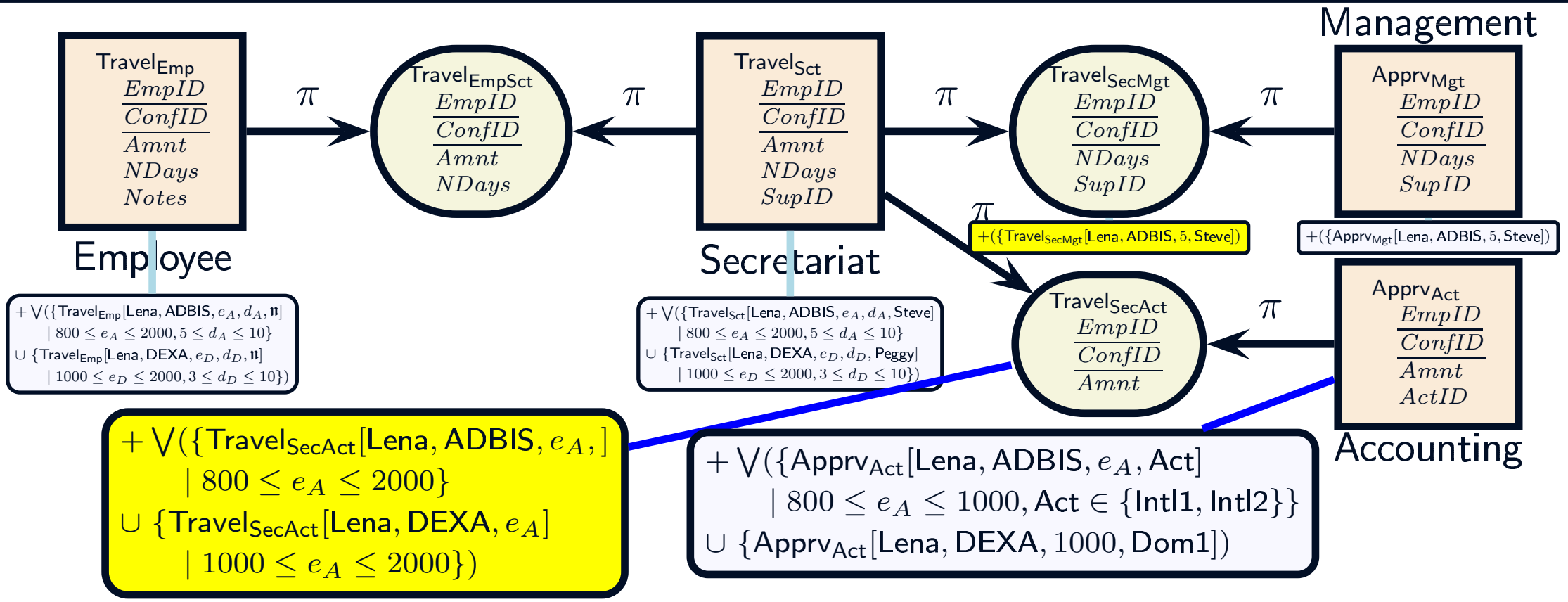

- Manager Steve processes the request, and decides to allow Lena to attend ADBIS for five days.

# Example: Evolution of Travel Request and Authorization



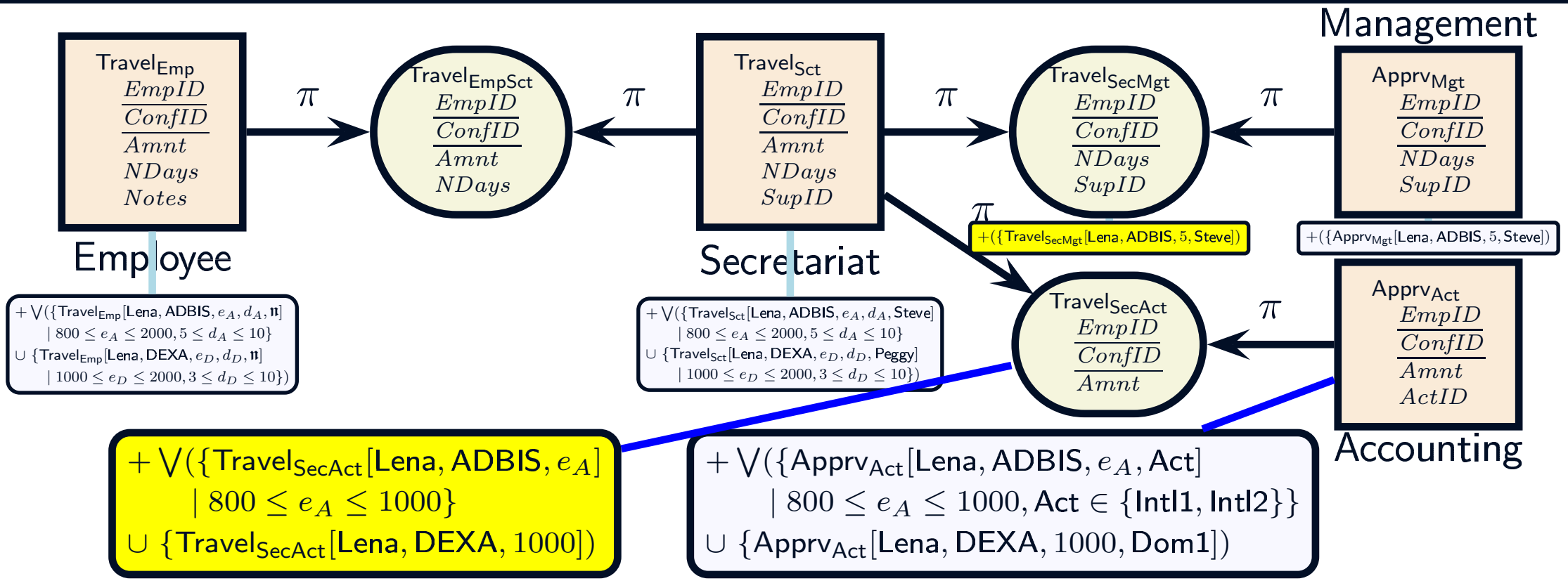

- The value in the port-status register for the Management component is removed, but a new value for the port-status register for Secretariat is inserted.

# Example: Evolution of Travel Request and Authorization



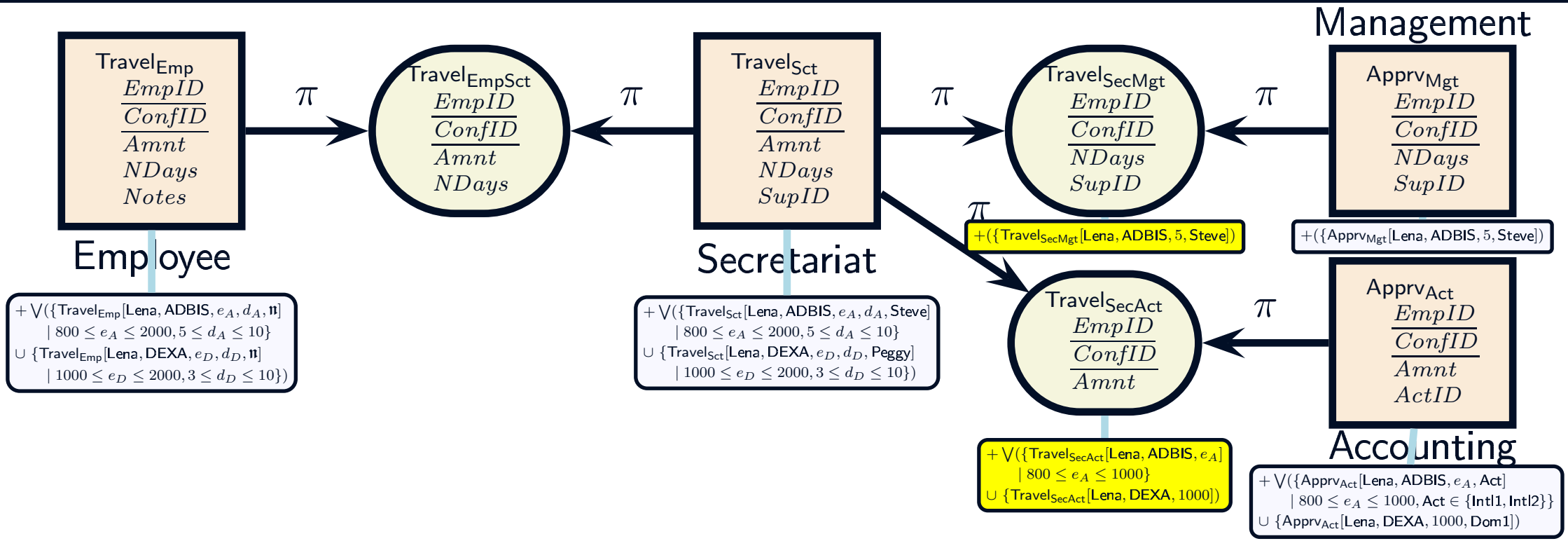

- Now consider the problem of lifting the projected update to the Management component.
  - The accounting manager decides to award €1000 for the requested travel.
  - The appropriate accounts are also identified.

# Example: Evolution of Travel Request and Authorization



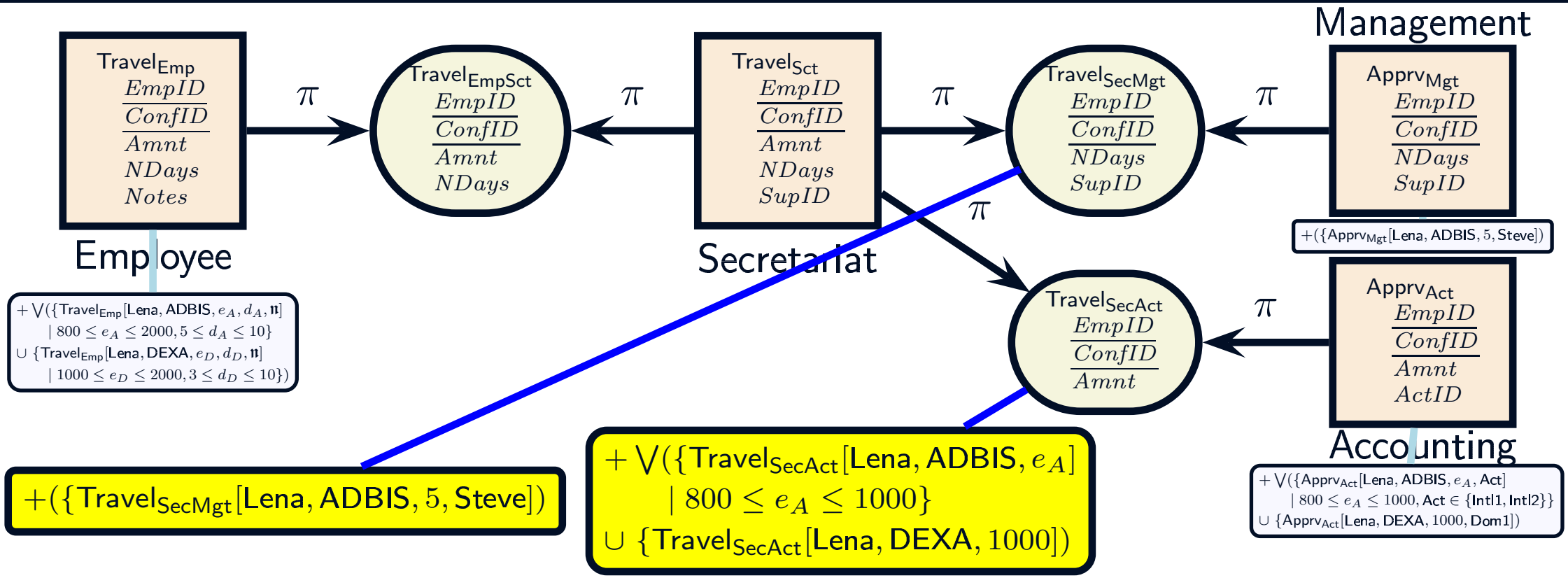

- The value in the port-status register for the Accounting component is cleared, but a new value for the port-status register for Secretariat is inserted.

# Example: Evolution of Travel Request and Authorization



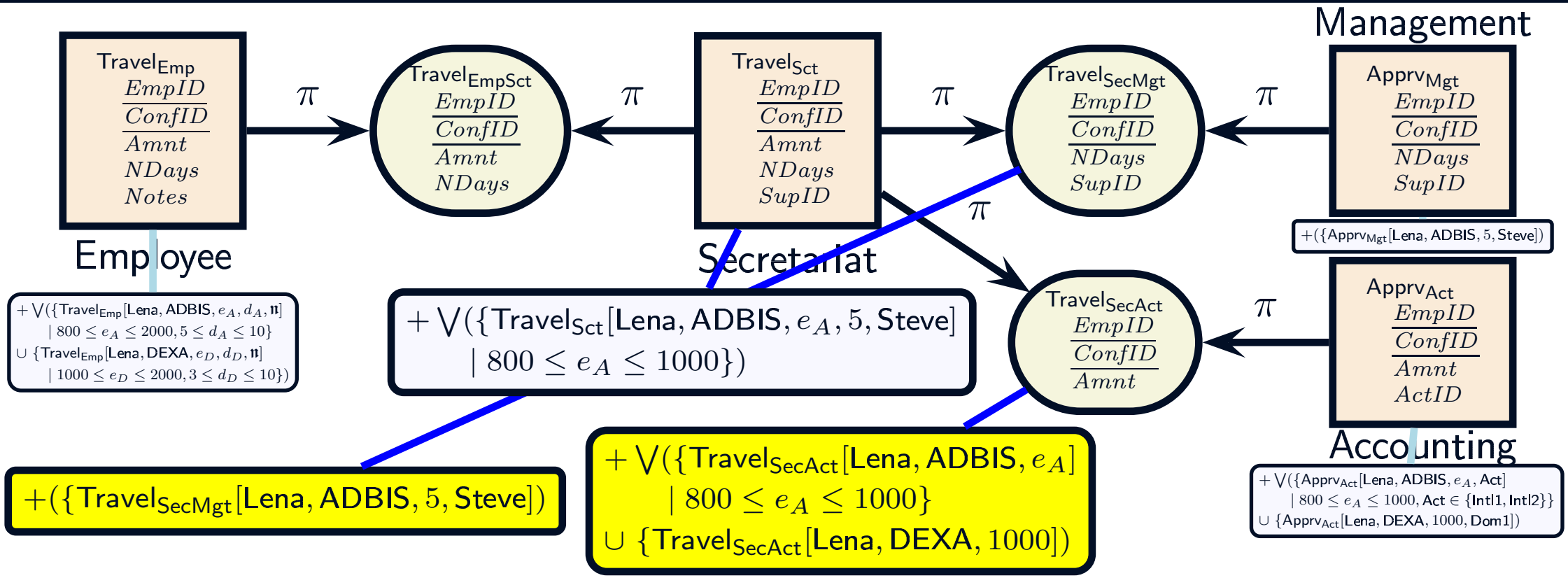

- Now the update negotiation propagates back right to left.

# Example: Evolution of Travel Request and Authorization



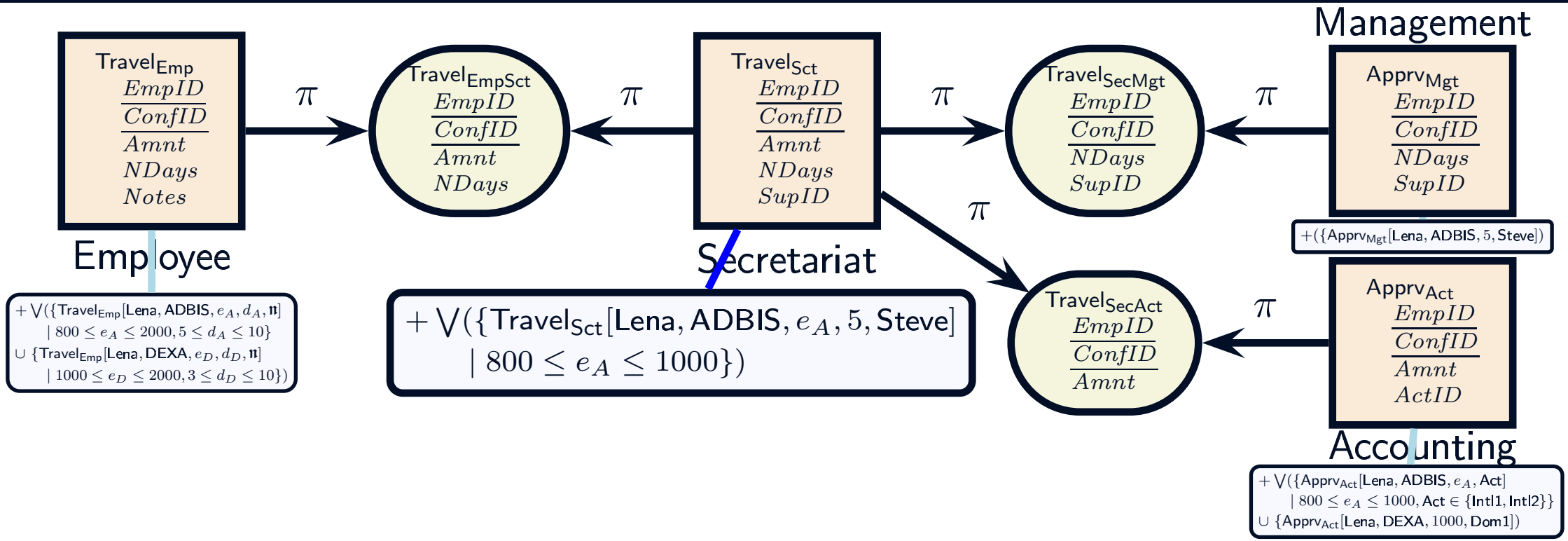

- The two values in the port-status registers must be lifted to the Secretariat component simultaneously.

# Example: Evolution of Travel Request and Authorization



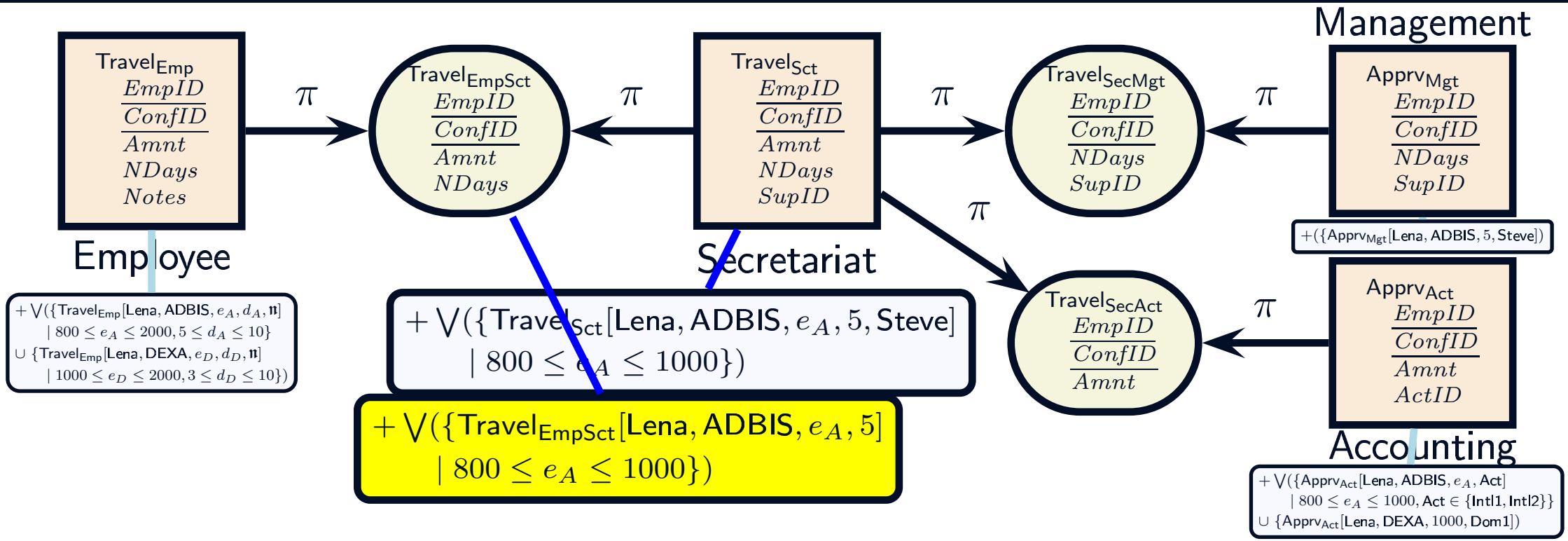

- Here is the maximal lifting.
  - The Secretariat makes imposes no additional limitations.

# Example: Evolution of Travel Request and Authorization



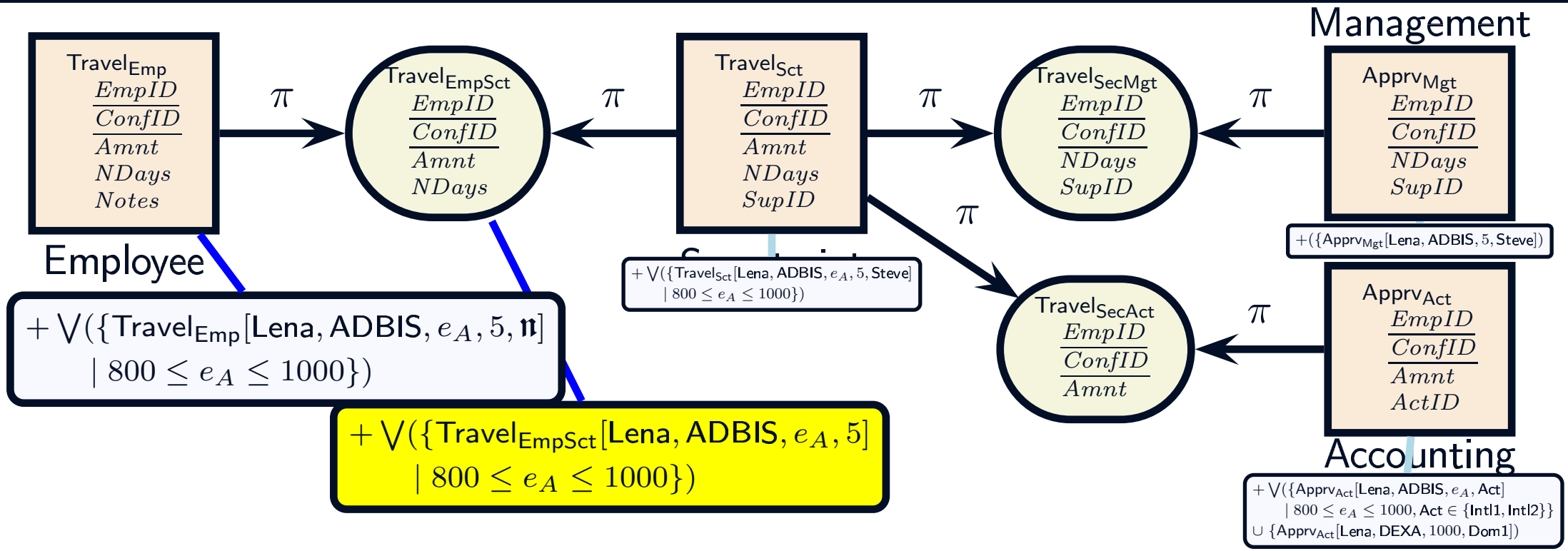

- The two port-status registers are now cleared.

# Example: Evolution of Travel Request and Authorization



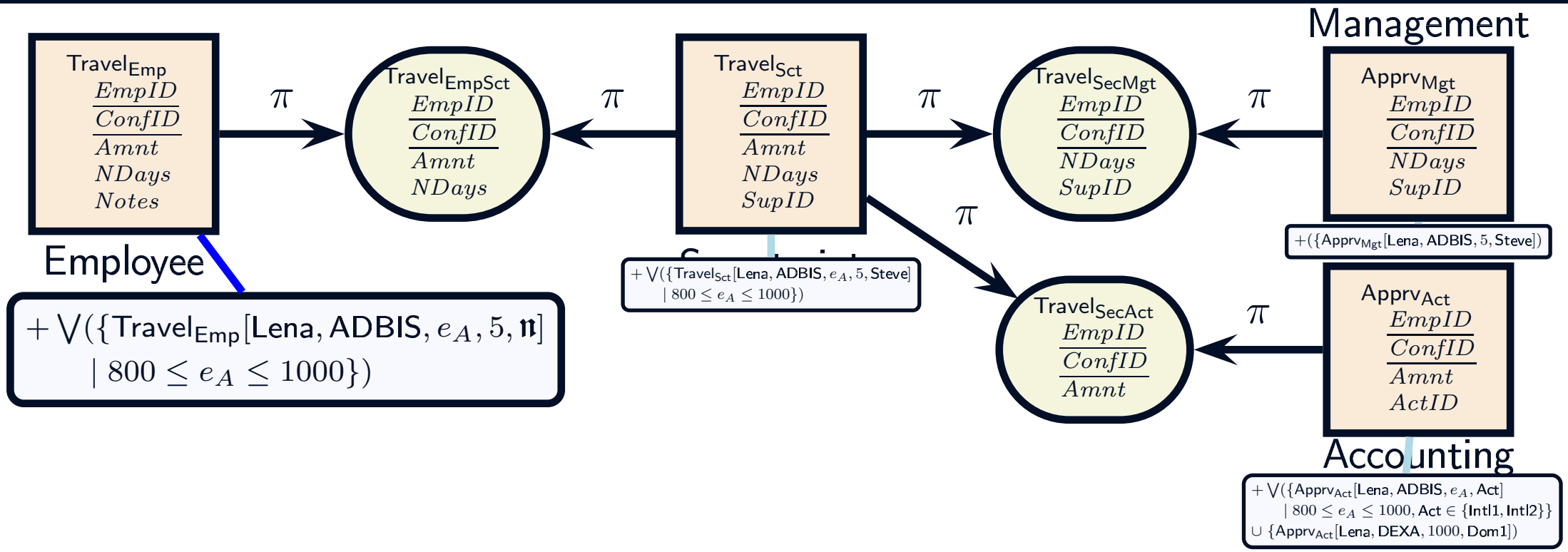

- The update request is then projected to the appropriate port-status register connecting Secretariat to Employee.

# Example: Evolution of Travel Request and Authorization



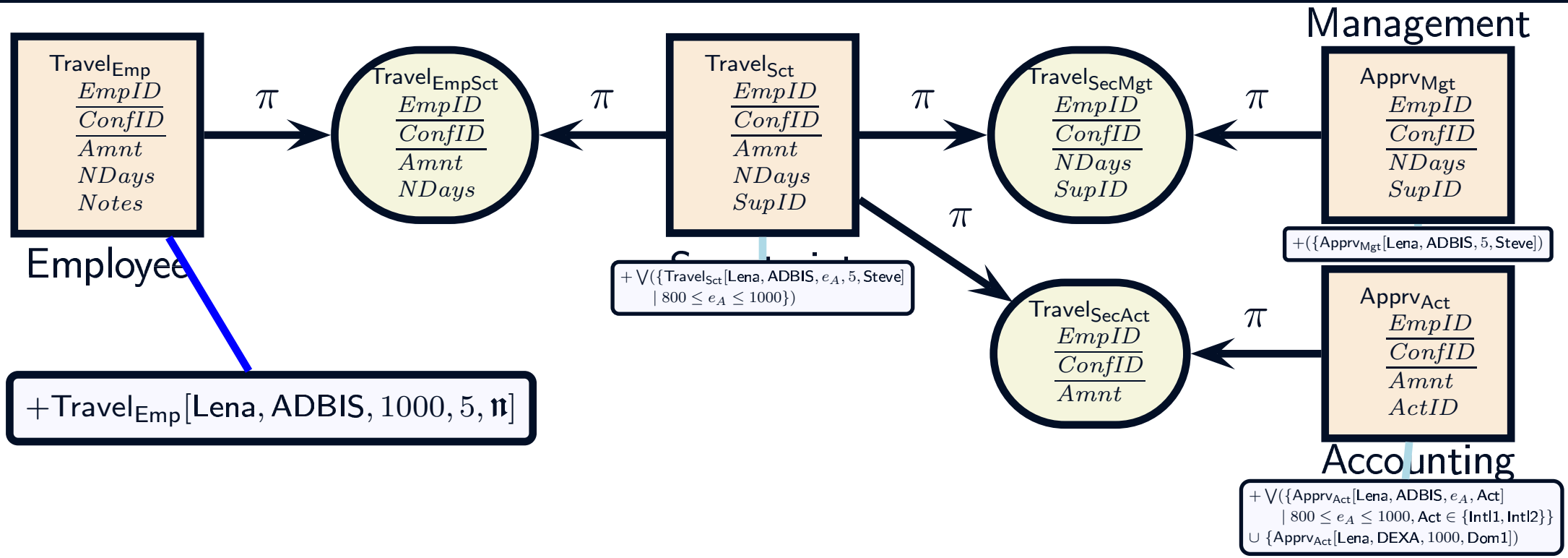

This update request is then lifted to the Employee component.

# Example: Evolution of Travel Request and Authorization



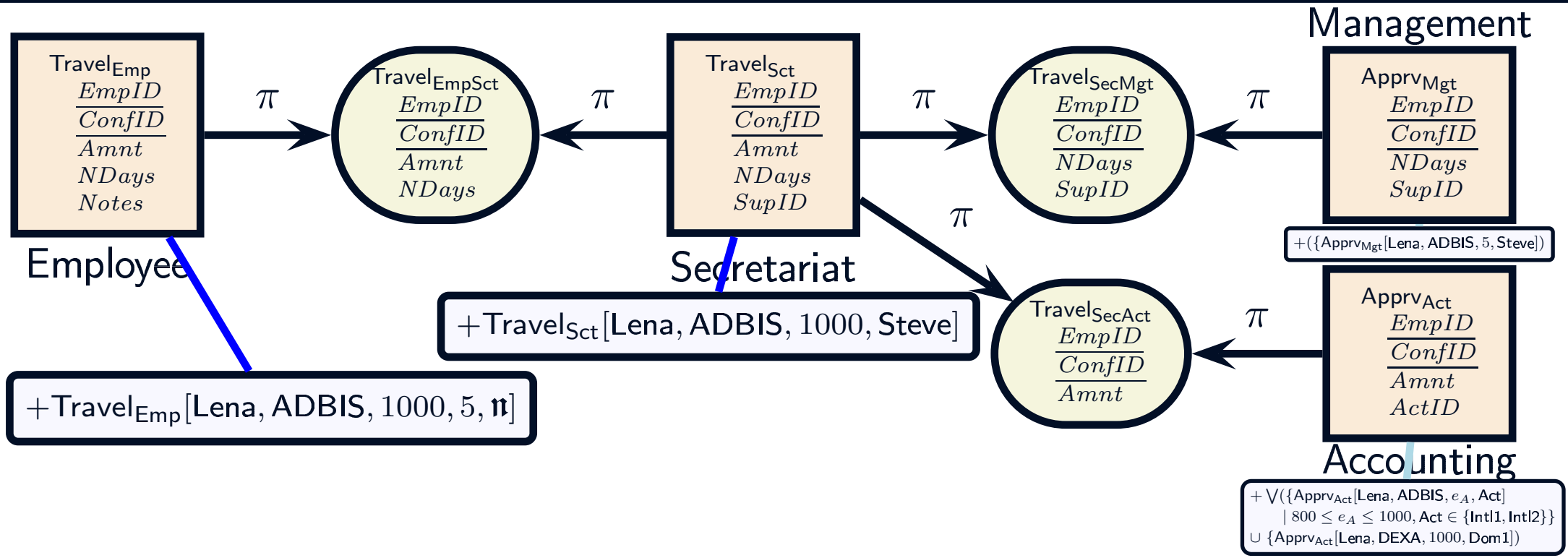

- The port-status register is cleared.
- Note that all port-status registers are now clear.

# Example: Evolution of Travel Request and Authorization



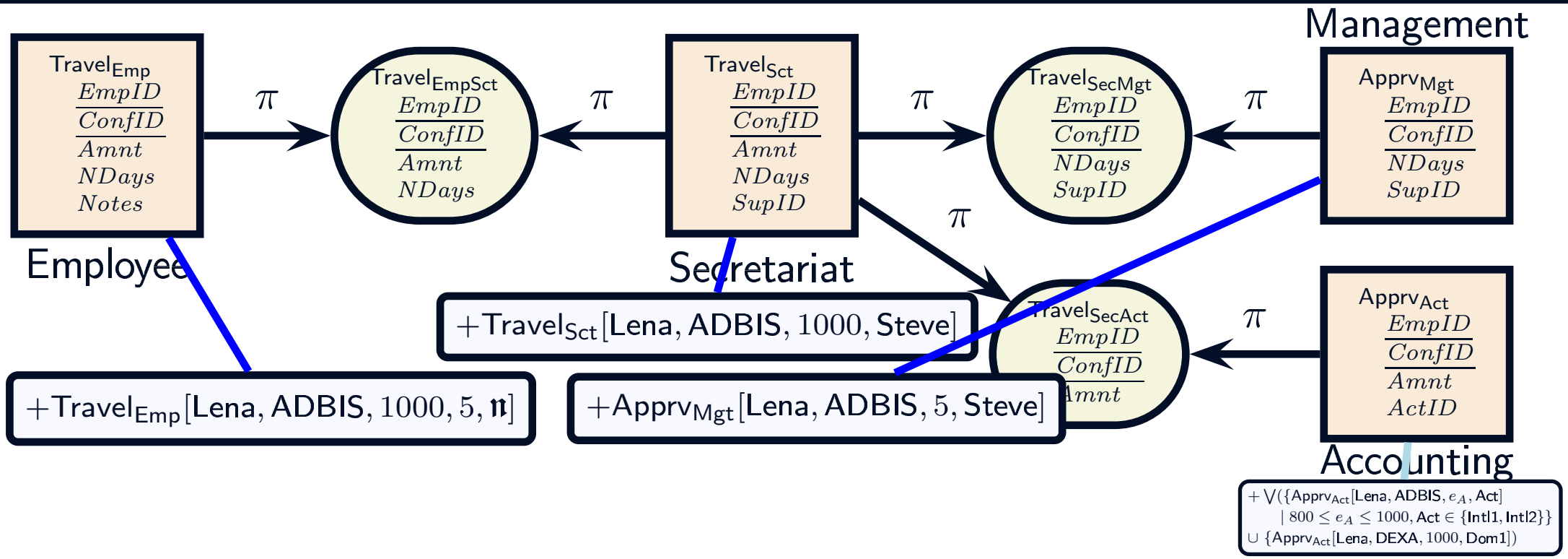

- Finally, Lena selects an update from amongst the possibilities.

# Example: Evolution of Travel Request and Authorization




- This update is propagated to the other components for agreement.
- The messages passed through the port-status registers are not shown.

# Example: Evolution of Travel Request and Authorization

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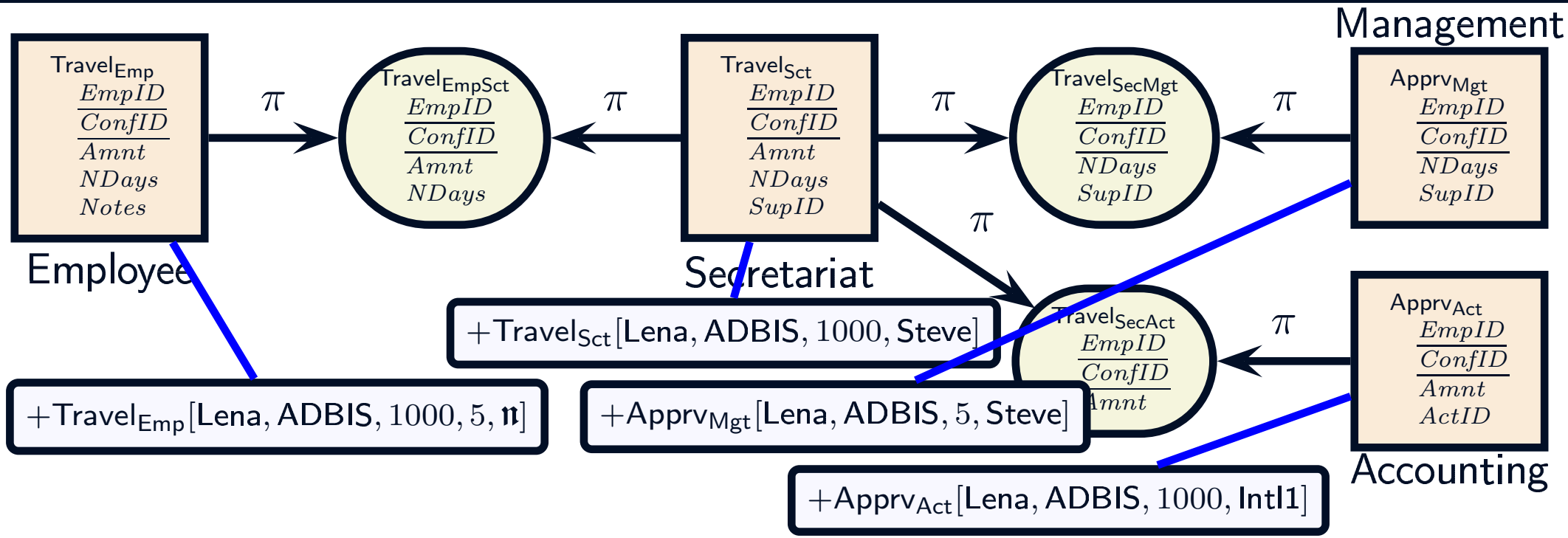


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- Note that a decision of which account to use is made by Accounting, but is not propagated since it is local to that component.

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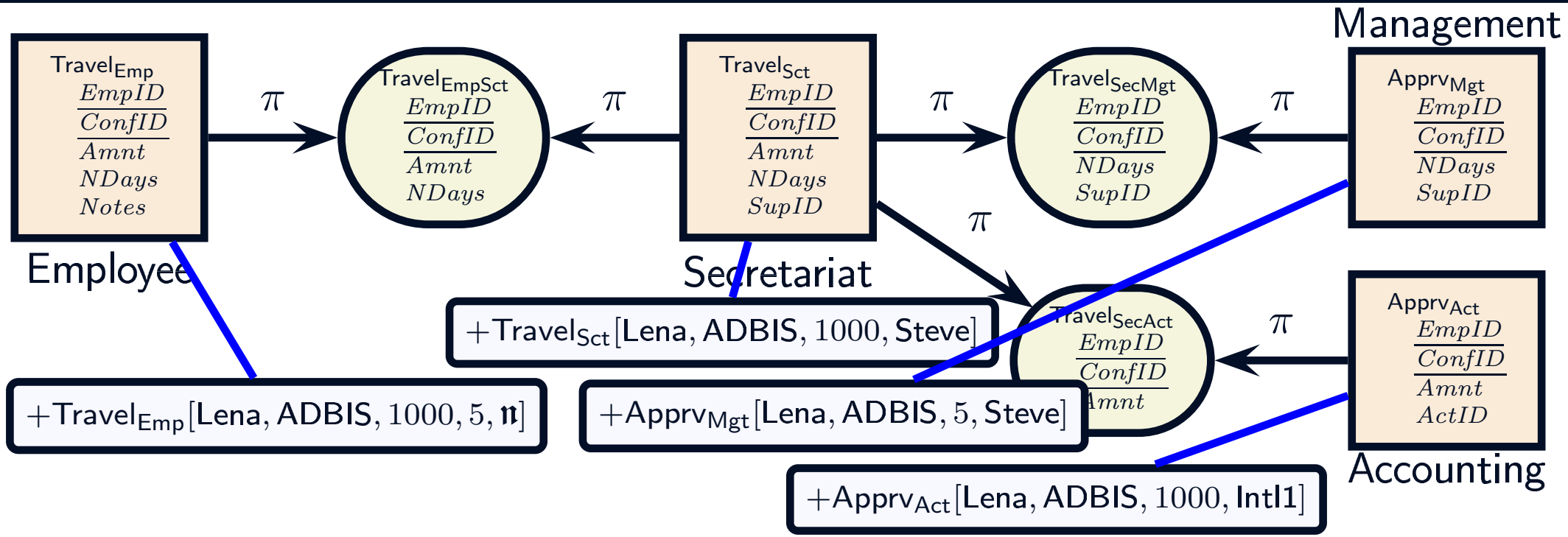


# Commit!

- Finally, these proposed updates may be committed to the database.

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**Theorem** The negotiation process always terminates. Negotiations which proceed indefinitely are not possible. □

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- The precise way in which cooperative update defines constraints on the possible workflow patterns for the system warrants further study.