EXTENDS *Transactions*

INSTANCE *Naturals*

INSTANCE *FiniteSets*

INSTANCE *Sequences*

LOCAL INSTANCE *TLC*

─────────────────────────────────────

This section models configuration changes and rollbacks. Changes are appended to the transaction log and processed asynchronously.

$Value(s, t, p) \triangleq$
   LET $value \triangleq$ CHOOSE $v \in s : v.target = t \land v.path = p$
   IN
      $[value \mapsto value.value,$
       $delete \mapsto value.delete]$

$Paths(s, t) \triangleq$
   $[p \in \{v.path : v \in \{v \in s : v.target = t\}\} \mapsto Value(s, t, p)]$

$Changes(s) \triangleq$
   $[t \in \{v.target : v \in s\} \mapsto Paths(s, t)]$

$ValidValues(t, p) \triangleq$
   UNION $\{\{[value \mapsto v, delete \mapsto \text{FALSE}] : v \in Target[t].values[p]\}, \{[value \mapsto Nil, delete \mapsto \text{TRUE}]\}\}$

$ValidPaths(t) \triangleq$
   UNION $\{\{v @@ [path \mapsto p] : v \in ValidValues(t, p)\} : p \in \text{DOMAIN } Target[t].values\}$

$ValidTargets \triangleq$
   UNION $\{\{p @@ [target \mapsto t] : p \in ValidPaths(t)\} : t \in \text{DOMAIN } Target\}$

The set of all valid sets of changes to all targets and their paths.

The set of possible changes is computed from the *Target* model value.

$ValidChanges \triangleq$
   LET $changeSets \triangleq \{s \in \text{SUBSET } ValidTargets :$
                        $\forall t \in \text{DOMAIN } Target \quad :$
                        $\forall p \in \text{DOMAIN } Target[t].values :$
                        $Cardinality(\{v \in s : v.target = t \land v.path = p\}) \leq 1\}$
   IN
      $\{c \in \{Changes(s) : s \in changeSets\} :$
        $\text{DOMAIN } c \neq \{\} \land \forall t \in \text{DOMAIN } c : \text{DOMAIN } c[t] \neq \{\}\}$

Add a set of changes 'c' to the transaction log

$RequestChange(c) \triangleq$
   LET $index \triangleq Len(transaction) + 1$
   IN $\exists\, isolation \in \{ReadCommitted,\ Serializable\} :$
        $\land\, transaction' = transaction\ @@\ (index :> [type \quad \mapsto TransactionChange,$
                                                          $isolation \mapsto isolation,$
                                                         $change \quad \mapsto c,$
                                                         $targets \quad \mapsto [t \in \{\} \mapsto 0],$
                                                         $phase \quad \mapsto TransactionInitialize,$
                                                         $state \qquad \mapsto TransactionInProgress,$
                                                         $status \qquad \mapsto TransactionPending])$

Add a rollback of transaction 't' to the transaction log
$RequestRollback(i) \triangleq$
   LET $index \triangleq Len(transaction) + 1$
   IN $\exists\, isolation \in \{ReadCommitted,\ Serializable\} :$
        $\land\, transaction' = transaction\ @@\ (index :> [type \qquad \mapsto TransactionRollback,$
                                                          $isolation \mapsto isolation,$
                                                        $rollback \mapsto i,$
                                                         $targets \quad \mapsto [t \in \{\} \mapsto 0],$
                                                         $phase \quad \mapsto TransactionInitialize,$
                                                         $state \quad \mapsto TransactionInProgress,$
                                                         $status \quad \mapsto TransactionPending])$

$RequestSet \triangleq$
   $\lor\ \exists\, c \in ValidChanges :$
      $RequestChange(c)$
   $\lor\ \exists\, i \in \text{DOMAIN}\ transaction :$
      $RequestRollback(i)$

Formal specification, constraints, and theorems.
$InitNorthbound \triangleq \text{TRUE}$

$NextNorthbound \triangleq$
   $\lor\ RequestSet$

\ * Modification History
\ * Last modified Sun *Feb* 20 10:10:06 *PST* 2022 by *jordanhalterman*
\ * Created Sun *Feb* 20 03:08:25 *PST* 2022 by *jordanhalterman*