Peer to Peer Collaborative Editing on XML-like trees

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Collaborative Edition System

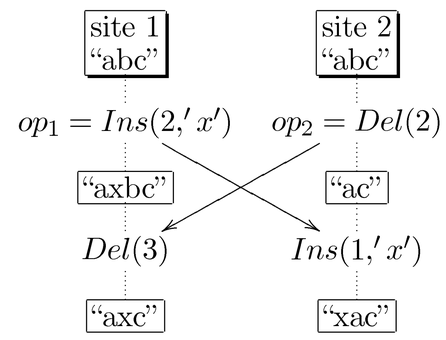
1 Centralize (SVN, CVS, ...)

- **Benefits :**
  - One Master Copy (no Divergence)
  - Lock is possible
  - Mastering authorization
- **Drawback :**
  - Need a big server ⇒ Maintenance
  - Accept a limited number of user.
  - Hack (Denial of services, Lost Data, ...)

Collaborative Edition System

2 Peer to Peer

- **Benefits :**
  - Flexibility
  - Cheaper
  - Stronger
- **Drawback :**
  - The lock is impossible
  - The management is hard
  - Divergence example (Grove) :



Existing Systems

- Word case :
  - Groove (case of divergence)
  - REDUCE (rare case of divergence)
  - Work of Imine (convergence proof but without structure) [1]
- XML Documents
  - Relies on Time Stamp (SO6 en on SOCT4 [4] - Need a centralization) [3]
  - A few publication on XML is not really peer to peer

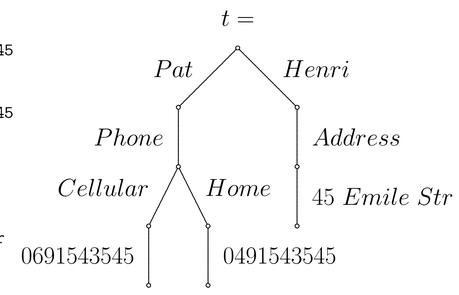
Our goal

Our goal is to create a collaborative editor which is :
–Reactive (Synchronous) } Operational approach
–Easy to use (P2P) } (because state approach do a big message).
–Secure } Future Work with security policy
–Manageable

Our Model Document

```
<Pat>
   <Phone>
      <Cellular>
         0691543545
      </Cellular>
      <Home>
         0491543545
      </Home>
   </Phone>
</Pat>
<Henri>
   <Address>
      45 Emile Str
   </Adress>
</Henri>
```

$t =$



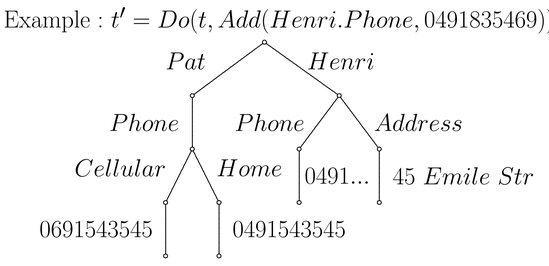
$$t = \left\{ Pat\left(\left\{ Phone\left(\left\{ \begin{array}{l} Home(\{0491543545(\{\})\}) \\ Cellular(\{0691543545(\{\})\}) \end{array} \right\}\right)\right\}\right) \\ Henri(\{Address(\{45\text{ Emile Str}(\{\})\})\}) \right\}$$

(Focussed on the structure)

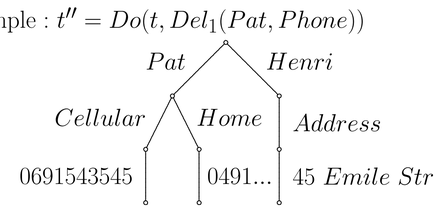
Our tree are :
– Unordered
– Unranked
– Edge labeled
– Unicity of label under a node

Operations on our document

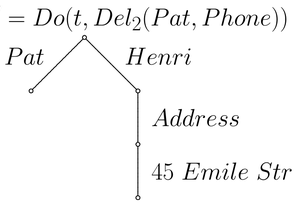
– Add Example : $t' = Do(t, Add(Henri.Phone, 0491835469))$



– Del_1 Example : $t'' = Do(t, Del_1(Pat, Phone))$



– Del_2 Example : $t''' = Do(t, Del_2(Pat, Phone))$



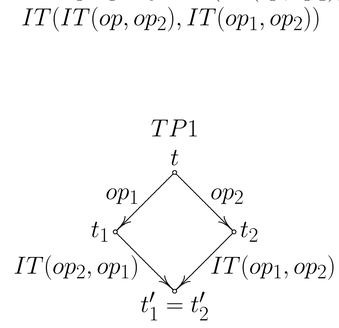
– Nop Does nothing.

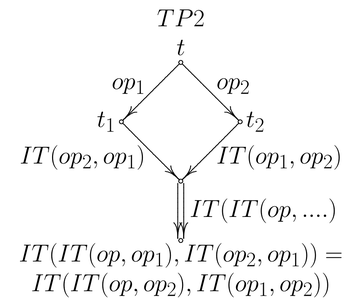
Definition

$Do : State \times Op \to State$ (Apply a operation)
$IT : Op \times Op \to Op$ (Transform an operation in case on concurrent operation this function ensure the convergence)
$(t)[op_1; op_2; ...; op_n] = Do(op_n, ..., Do(op_2, Do(op_1, t))...)$

Convergence ensured if TP1 and TP2 [2]

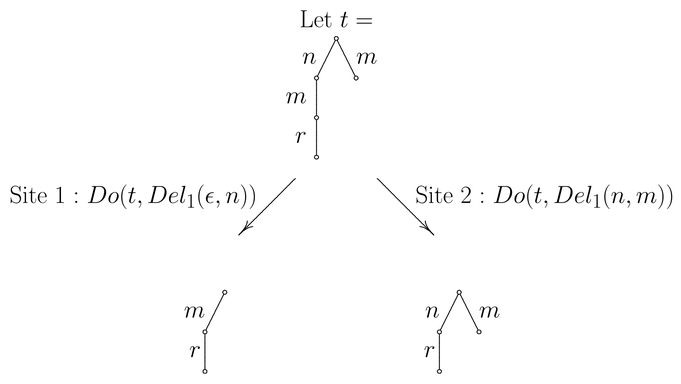
– $TP1$ property : $(t)[op_1; IT(op_2, op_1)] = (t)[op_2; IT(op_1, op_2)]$
– $TP2$ property : $IT(IT(op, op_1), IT(op_2, op_1)) = IT(IT(op, op_2), IT(op_1, op_2))$





Our contribution (Negative result)

No IT exist on Add, Del_1, Nop Operations.
State :



To have convergence, we need obtain a same state on this two site with one operation by site. It's impossible with this model.

Our contribution (Positive result)

IT exist on Add, Del_2, Nop Operations.

We write $p_1 \lhd p_2$, when a path p_1 is a prefix of another path p_2.
$IT(op_1, op_2) =$

$$\begin{cases} IT(Add(p,n), Add(p',n')) = Add(p,n), \\ IT(Add(p,n), Del_2(p',n')) = \begin{cases} Nop(), \text{ if } p = p' \wedge n = n' \\ Nop(), \text{ if } p'.n' \lhd p \\ Add(p,n), \text{ else.} \end{cases} \\ IT(Del_2(p,n), Add(p',n')) = Del_2(p,n) \\ IT(Del_2(p,n), Del_2(p',n')) = \begin{cases} Nop(), \text{ if } p = p' \wedge n = n' \\ Nop(), \text{ if } p'.n' \lhd p \\ Del_2(p,n), \text{ else.} \end{cases} \\ IT(op_1, Nop()) = op_1 \\ IT(Nop(), op_2) = Nop(); \end{cases}$$

We prove in our paper this IT is $TP1$ and $TP2$

Future works

– Add $Move$ operation.
– Allow multiple occurrences of the same label under a node.
– Add a order
– Add a schema
– Add a security policy

References

[1] Abdessamad Imine. *Conception Formelle d'Algorithmes de Réplication Optimiste. Vers l'Edition Collaborative dans les Réseaux Pair-à-Pair.* PhD thesis, Université Henri Poincaré, Nancy, décembre 2006.

[2] Brad Lushman and Gordon V. Cormack. Proof of correctness of ressel's adopted algorithm. *Inf. Process. Lett.*, 86(6) :303–310, 2003.

[3] Gérald Oster, Hala Skaf-Molli, Pascal Molli, and Hala Naja-Jazzar. Supporting Collaborative Writing of XML Documents. In *ICEIS 2007*, pages 335–342, Funchal, Madeira, Portugal, June 2007.

[4] Nicolas Vidot, Michelle Cart, Jean Ferrié, and Maher Suleiman. Copies convergence in a distributed real-time collaborative environment. In *CSCW '00 : Proceedings of the 2000 ACM conference on Computer supported cooperative work*, pages 171–180, New York, NY, USA, 2000. ACM.