Modeling and Verification of Temporal Constraints for Web Service Composition

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1. INTRODUCTION

- **Problem.** This work aims to verify temporal constraints for Web service composition. The expected deployment of such verification when composing services strongly depends on the development of an adequate solution that guarantees a high level of service quality to the system users.

- **Challenge.** Given the importance of e-commerce solutions for Algerian citizens that are favorable to it due to the current confinement situation during the Covid-19 pandemic, we develop a Web service composition that studies the speed distribution of Every Consumer Goods in Algeria by using the Timed Colored Petri Nets formalism.

- **How.** Once the temporal constraints are identified and the formal model is developed, we analyze the performance by creating a monitor on which multiple simulations are performed by using the software CPN Tools allowing the collection of several time data, which are evaluated thereafter using the Java Framework.

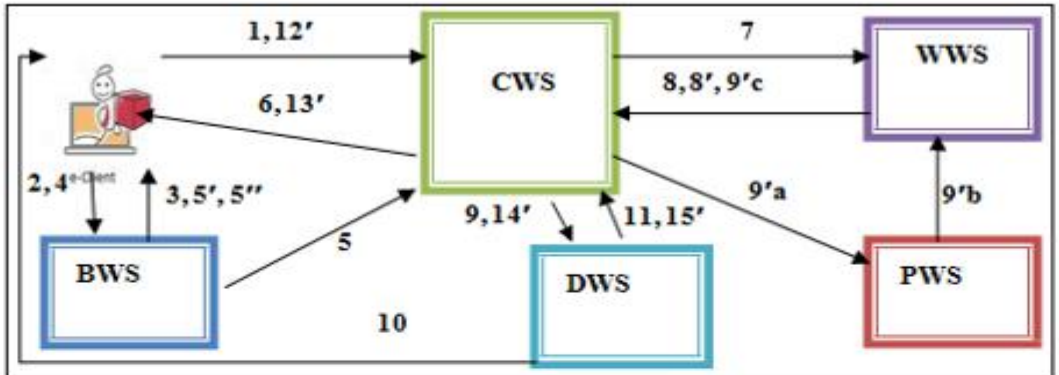
PLAN

1. INTRODUCTION
2. MOTIVATION SCENARIO
3. PROPOSED APPROACH
4. RESULTS AND PERSPECTIVES

2. MOTIVATION SCENARIO (1/2)

- Despite the widespread use of e-commerce, shopping Everyday Consumer Goods (ECG) online remains so far limited in Algeria.
- COVID-19 confinement in Algeria shows that households are still committed to traditional forms of retail, for which going out home remains necessary.
- Substantial efforts are being made by the commerce ministry in order to control delivery supply chains, both in terms of time span and correct pricing. The online sale has just started in many parts of the country, and various items are ordered, mostly via social networks and delivered on time. These actions are helping to enforce the confinement but still insufficient and poorly organized.
- Consequently, the Algerian Government needs to raise the general awareness of e-commerce. In this context, the present paper examines an e-commerce scenario that considers temporal constraints.

2. MOTIVATION SCENARIO (2/2)



Legend:

1: Order
2: Payment Order
3: Payment Verification
4: Payment Confirmation
5: Payment Notification
5′: Error Confirmation Notification
5″: Error Payment Notification
6: Bill
7: Order
8: Exist Notification
8′: Not Exist Notification

9′a: SupplyOrder
9′b: Supply
9′c: SupplyNotification
9: Delivery Order
10: Goods
11: Delivery Confirmation
12′: Item
13′: Mailing Label
14′: Return Order
15′: Return Confirmation

1,2,3.. : Sequence

a, b, c : Sequence

′, ″: Alternative

→: Message

4. PROPOSED APPROACH

A. Three main steps

1. **TCPN-based Modeling:** The formal modeling of each Web service is performed by making use of the TCPN semantics based on the color set and the time step concepts. The set local temporal constraints are first modeled. Then, the TCPN composition model is performed and the global temporal constraints are next considered. Multiple simulations are performed frequently to check whether the formal model behaves as expected.

2. **CPN Tools-based Monitoring:** We make use of the "User defined" component in the software CPN Tools. This monitor is associated to all TCPN transitions forming our ECG application.

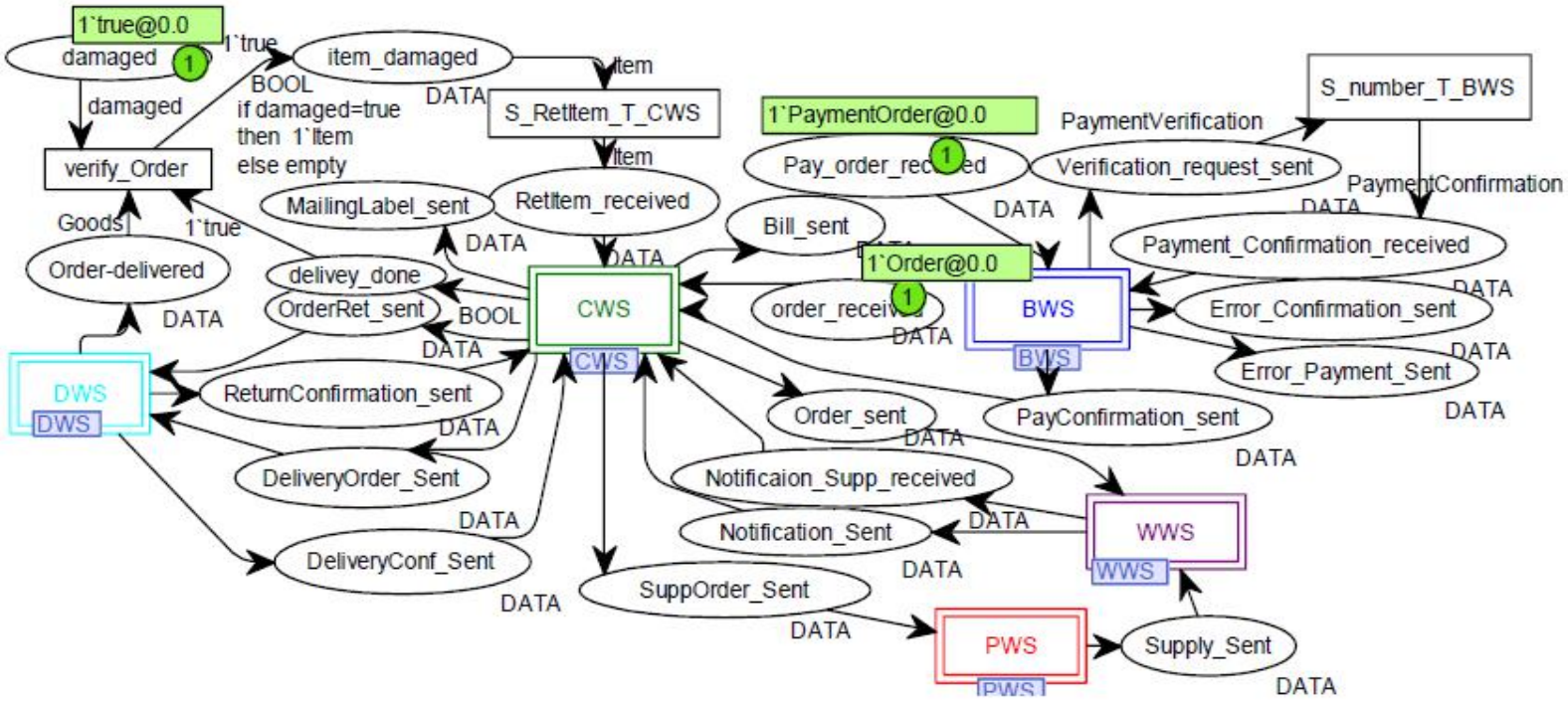
3. **Java Framework-based Evaluation:** We run a simulation at the CPN Tools. Meanwhile, Java receives the transmitted data through the monitor in order to visualize a clear simulation. It uses the transferred model of the transitions in or-der to compute the execution time of each temporal constraint during the simulation and comparing them with those added during the modeling. Finally, a Java library is used for generating a graph, which shows the execution time for the transitions associated to temporal constraints over steps.

If some constraints are not verified, then we should return towards the model for correct it.

4. PROPOSED APPROACH
B. Temporal constraints

Temporal Constraint	Web service	Type	Time Unit (TU)
TC1	BWS	Local	0.25-0.5 TU
TC2	BWS	Local	0.25-0.3 TU
TC3	BWS	Local	0.5-1.0 TU
TC4	BWS	Local	0.4-0.5 TU
TC5	CWS	Local	27-32 TU
TC6	CWS/WWS	Global	2-3 TU
TC7	CWS /PWS/WWS	Global	120-210 TU
TC8	CWS /DWS	Global	2880-5760 TU
TC9	CWS /DWS	Global	7200-14400 TU

4. PROPOSED APPROACH
Step 1. TCPN-based Modeling



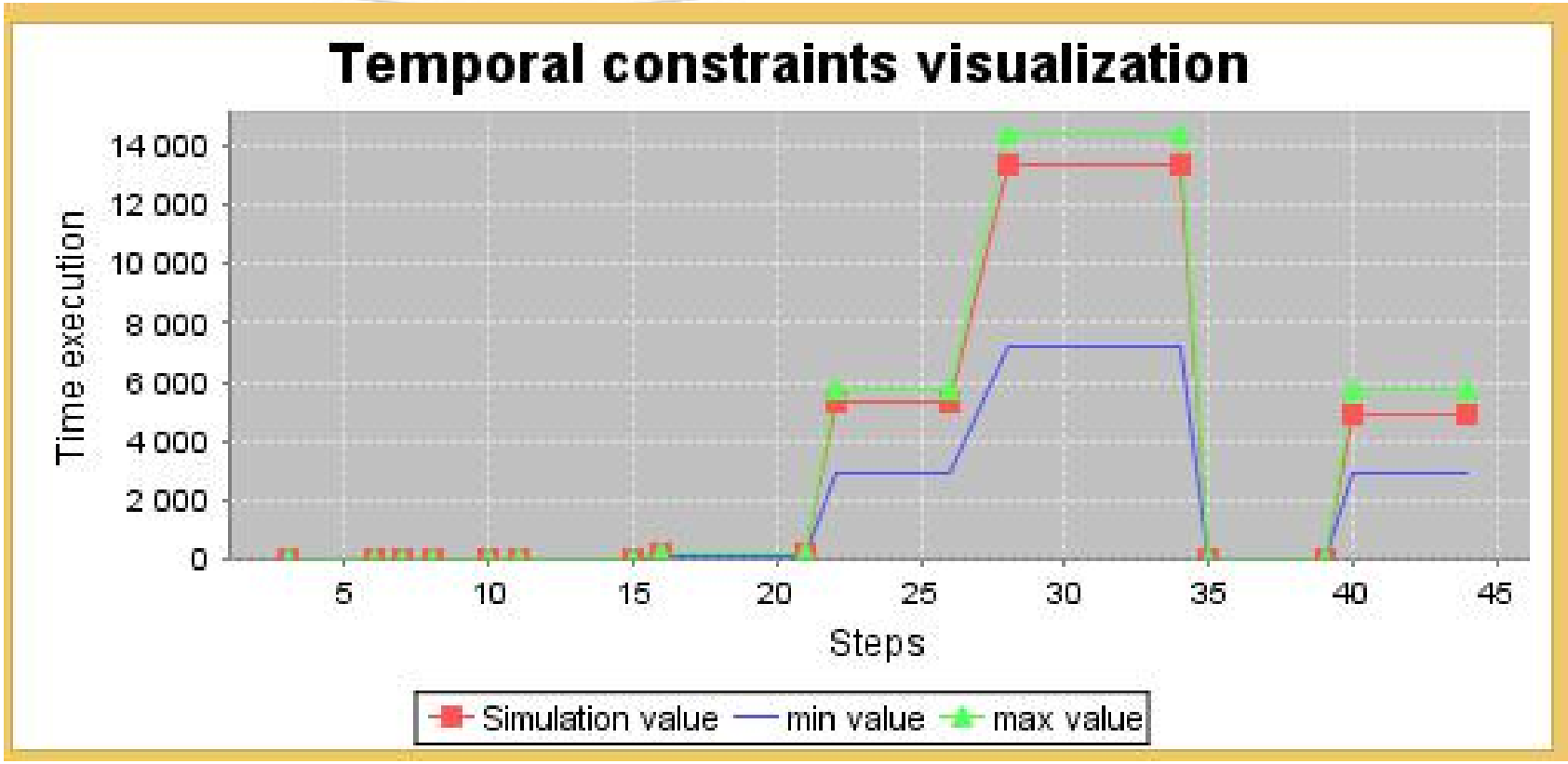
4. PROPOSED APPROACH

Step 2. CPN Tools-based monitoring

```
▼Java monitor
   Type: User defined
  ►Nodes ordered by pages
  ▼Init
      fun init () =
        if !connected = true
        then (ConnManagementLayer.closeConnection("Conn 1");
              connected := false)
        else ()
  ►Predicate
  ►Observer
  ▼Action
      fun action (s1,s2,s3,s4) =
        (if not(!connected)
        then (ConnManagementLayer.acceptConnection("Conn 1",9000);
              connected:=true)
        else ();
        send_to_Java(s1,s2,s3,s4))
  ▼Stop
      fun stop () =
        if !connected = true
        then (ConnManagementLayer.closeConnection("Conn 1");
              connected := false)
        else ()
```

4. PROPOSED APPROACH

Step 3. Java framework-based evaluation



5. CONCLUSION AND PERSPECTIVES

- The importance of an adequate management of temporal aspects of process aware information systems is beyond dispute.
- This work proposes a development process able to model and verify temporal constraints for Web service composition by using TCPN formalism, CPN Tools software and Java Framework.
- In doing so, and by an illustrative example, this work reveals that TCPN models based composition can be transferred into Java framework able to allow the developer to verify several temporal constraints.
- In future, the performance challenge will be discussed for the same case study but for other criteria such as security.


THANK YOU
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