

TRANSFORMING WEB SERVICES CHOREOGRAPHIES WITH PRIORITIES AND TIME CONSTRAINTS INTO PRIORITIZED-TIME PETRI NETS

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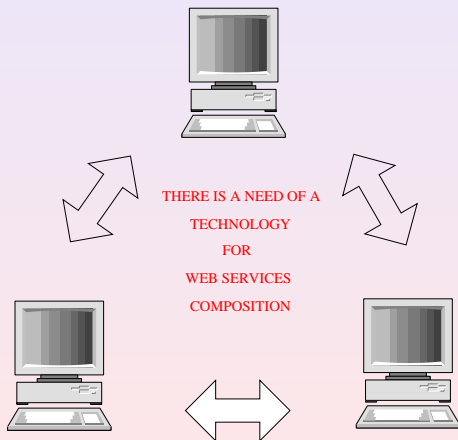
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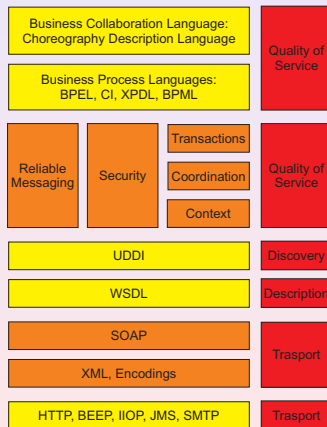
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MOTIVATION AND GOALS



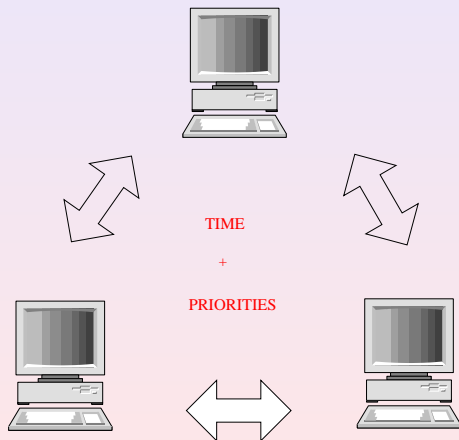
MOTIVATION AND GOALS



MOTIVATION AND GOALS

- **Choreography layer**: Collaboration of parties, establishing their common and complementary observable behaviour.
- Independent of platform or programming model.
- A contract among the different participants.
- Basic element: **interactions**.

MOTIVATION AND GOALS



MOTIVATION AND GOALS

- The PTPN representation provides a graphical view of the global behaviour.
- A tool can be used to simulate and analyse the system.

WS-CDL Elements

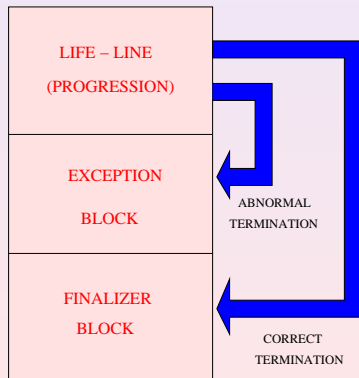
- Participants, Role Types and Relationship Types.
- Information Types, Variables and Tokens.
- Channels.
- Choreographies.
- Activities and Ordering Structures.
- Workunits.

CHOREOGRAPHIES

- They establish the common rules that govern the ordering of exchanged messages and the collaborative behaviour.

CHOREOGRAPHIES

Parts of a choreography:



CHOREOGRAPHIES

Activities: Work that the choreography must perform.

| BASIC ACTIVITIES | ORDERING STRUCTURES |
|---|---------------------|
| INTERACTION ACTIVITIES | SEQUENCE |
| ASSIGN, SILENT AND NOACTION ACTIVITIES | PARALLEL |
| | CHOICE |

TIME AND PRIORITIES IN WS-CDL

- Some parties may establish time restrictions for some interactions.
- Some parties may desire to favor some interactions by means of priorities.

TIME AND PRIORITIES IN WS-CDL

- Interaction activities may have a time-out associated.
- Date and Time variables can be used in the guards of workunits to delay the execution.
- Priorities can be introduced in interactions.

PRIORITIZED-TIME PETRI NETS

Definition (PTPN)

A PTPN is a tuple $N = (P, T, F, \alpha, \beta, \pi)$.

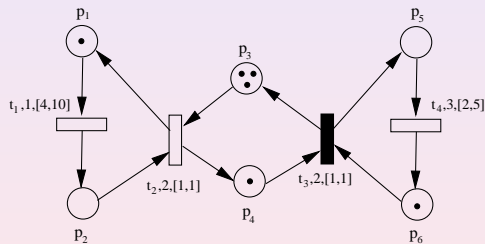
| | |
|--|--|
| P | Finite set of <i>places</i> |
| T | Finite set of <i>transitions</i> ($T = T_1 \cup T_2$) |
| F | Flow relation ($F \subseteq (P \times T) \cup (T \times P)$) |
| $\alpha : T \rightarrow \mathbb{N}$ | Earliest Static Firing Time |
| $\beta : T \rightarrow \mathbb{N} \cup \{\infty\}$ | Latest Static Firing Time |
| $\pi : T \rightarrow \mathbb{N}$ | Priority function |

PRIORITIZED-TIME PETRI NETS

Firing rule:

- When a transition becomes enabled a local clock is set.
- The transition can be fired when its clock has a value in its associated time interval.
- No time can elapse when a clock of a transition in T_2 reaches its latest firing time.

PRIORITIZED-TIME PETRI NETS



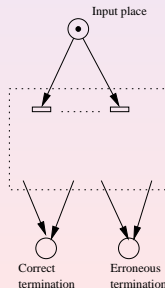
| Relative Time Bounds | |
|----------------------|-------|
| t_1 | [3,9] |
| t_2 | ----- |
| t_3 | [0,0] |
| t_4 | ----- |

PTPN SEMANTICS

- A subset of WS-CDL must be considered.
- Transitions are labelled with the roletypes involved in their execution.
- The obtained PTPNs are 1-safe.

PTPN SEMANTICS

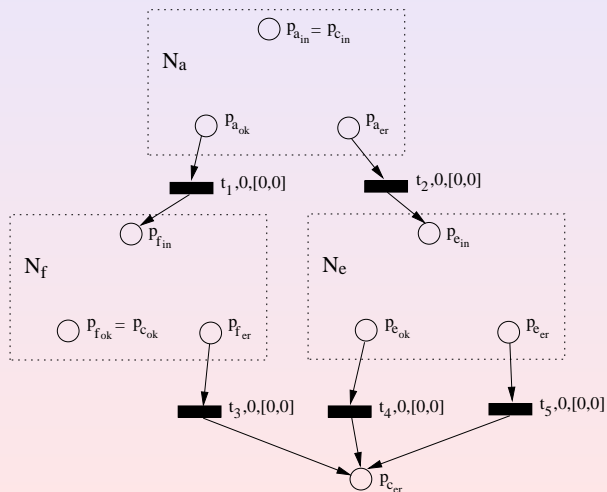
- There is one initial place which activates the PTPN when it is marked.
- There are two exit places: *correct* and *erroneous*. Only one of them can be finally marked.



PTPN SEMANTICS

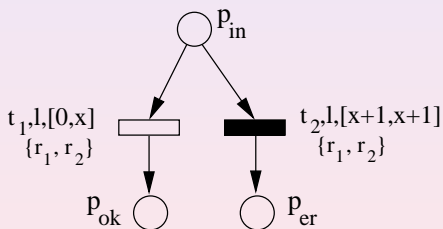
- Some elements of WS-CDL do not require a translation: RoleTypes, RelationshipTypes, ParticipantTypes, ChannelTypes and InformationTypes.
- Variables in general are not considered.
- Date and Time variables used to delay the execution are considered.
- Only a root choreography is considered.
- Activities and workunits are considered.

CHOREOGRAPHIES

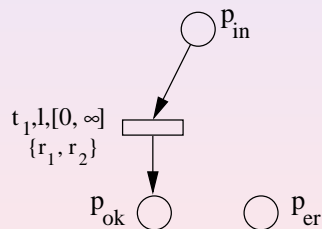


BASIC ACTIVITIES

Interaction activities:



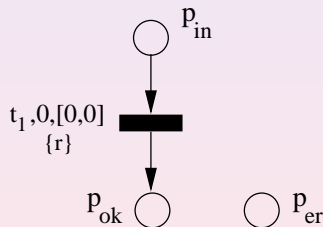
(a) With time-out



(b) Without time-out

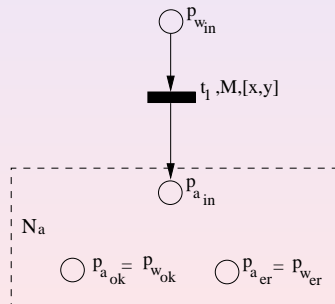
BASIC ACTIVITIES

Assign, Noaction and Silent activities:



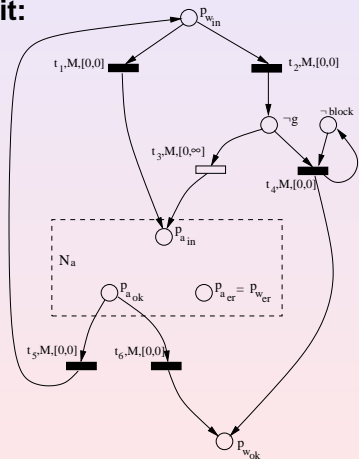
WORKUNITS

Delayed Workunit:



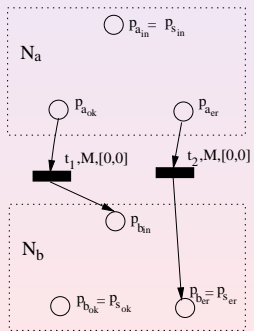
WORKUNITS

General Workunit:



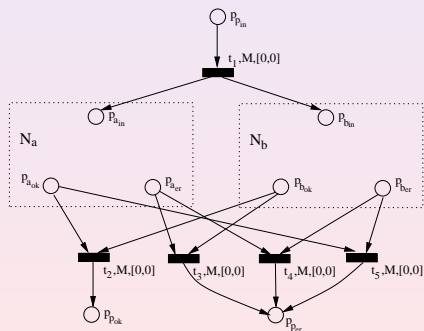
ORDERING STRUCTURES

Sequence:



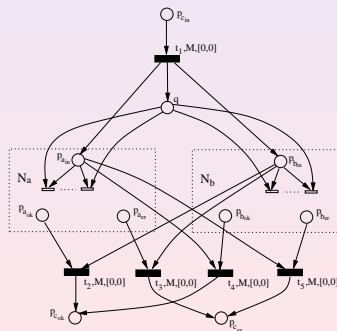
ORDERING STRUCTURES

Parallel:



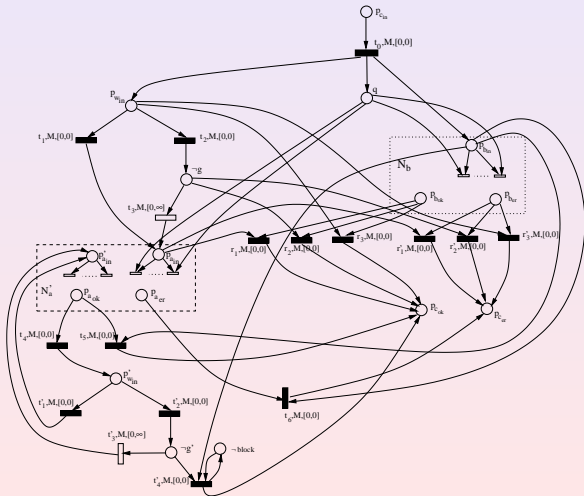
ORDERING STRUCTURES

Choice without general guarded workunits:



ORDERING STRUCTURES

Choice with repetitive general guarded workunit:

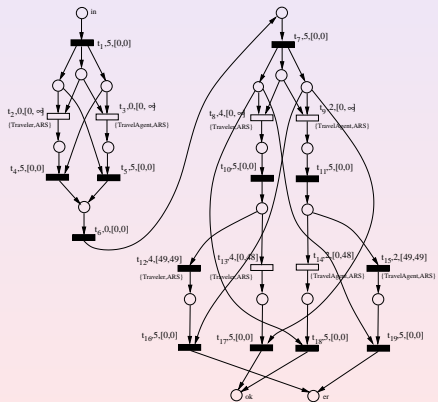


CASE STUDY

Airline ticket reservation system:

- Three role types: Traveler, Travel Agent, ARS.
- Request for flight information from travelers and travel agents.
- Bookings from travelers are priority.
- Reservations are valid for two days (up to confirmation).

PTPN FOR THE AIRLINE TICKET RESERVATION SYSTEM



CONCLUSIONS

- Choreographies establish the collaboration of the different parties.
- Time constraints are supported by WS-CDL.
- WS-CDL can be extended with priorities.
- A PTPN semantics can be provided for WS-CDL with time and priorities.

CONCLUSIONS

- PTPNs are a formal way to express the WS-CDL semantics.
- PTPNs can be used to simulate and analyse the system.

CURRENT AND FUTURE WORK

- A comparison with other semantics models of WS-CDL would be valuable.
- WST can be extended to support the PTPN semantics.