

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

V. Valero

M.E. Cambroner

G. Díaz

J.J. Pardo

Departamento de Sistemas Informáticos
Universidad de Castilla-La Mancha

Valentin.Valero@uclm.es

FLACOS 2007

CONTENTS

- 1** MOTIVATION AND GOALS
- 2 WS-CDL
- 3 TIME AND PRIORITIES IN WS-CDL
- 4 PRIORITIZED-TIME PETRI NETS (PTPNs)
- 5 PTPN SEMANTICS
- 6 CASE STUDY
- 7 CONCLUSIONS

CONTENTS

- 1** MOTIVATION AND GOALS
- 2** WS-CDL
- 3 TIME AND PRIORITIES IN WS-CDL
- 4 PRIORITIZED-TIME PETRI NETS (PTPNs)
- 5 PTPN SEMANTICS
- 6 CASE STUDY
- 7 CONCLUSIONS

CONTENTS

- 1** MOTIVATION AND GOALS
- 2** WS-CDL
- 3** TIME AND PRIORITIES IN WS-CDL
- 4 PRIORITIZED-TIME PETRI NETS (PTPNs)
- 5 PTPN SEMANTICS
- 6 CASE STUDY
- 7 CONCLUSIONS

CONTENTS

- 1** MOTIVATION AND GOALS
- 2** WS-CDL
- 3** TIME AND PRIORITIES IN WS-CDL
- 4** PRIORITIZED-TIME PETRI NETS (PTPNs)
- 5 PTPN SEMANTICS
- 6 CASE STUDY
- 7 CONCLUSIONS

CONTENTS

- 1 MOTIVATION AND GOALS
- 2 WS-CDL
- 3 TIME AND PRIORITIES IN WS-CDL
- 4 PRIORITIZED-TIME PETRI NETS (PTPNs)
- 5 PTPN SEMANTICS
- 6 CASE STUDY
- 7 CONCLUSIONS

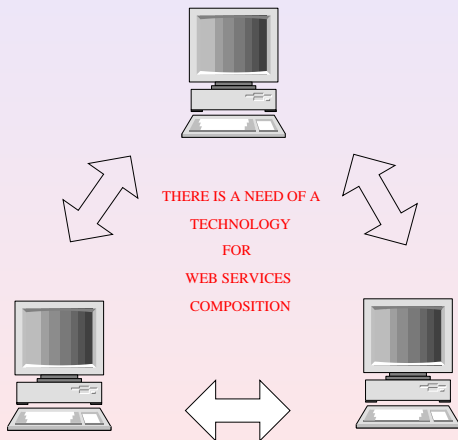
CONTENTS

- 1 MOTIVATION AND GOALS
- 2 WS-CDL
- 3 TIME AND PRIORITIES IN WS-CDL
- 4 PRIORITIZED-TIME PETRI NETS (PTPNs)
- 5 PTPN SEMANTICS
- 6 CASE STUDY
- 7 CONCLUSIONS

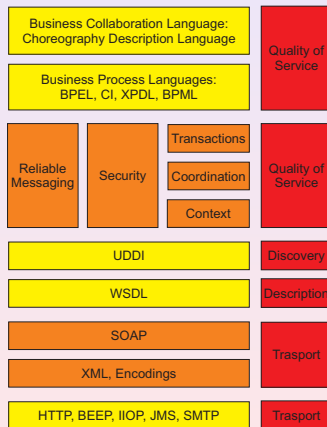
CONTENTS

- 1 MOTIVATION AND GOALS
- 2 WS-CDL
- 3 TIME AND PRIORITIES IN WS-CDL
- 4 PRIORITIZED-TIME PETRI NETS (PTPNs)
- 5 PTPN SEMANTICS
- 6 CASE STUDY
- 7 CONCLUSIONS

MOTIVATION AND GOALS



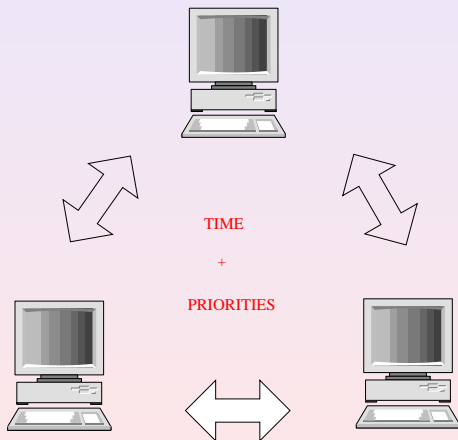
MOTIVATION AND GOALS



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

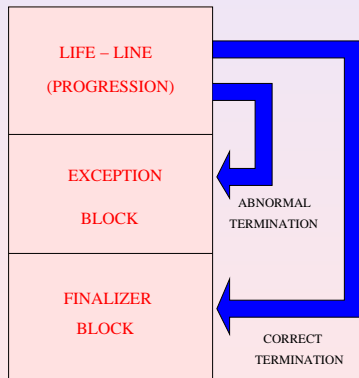
- Participants, Role Types and Relationship Types.
- Information Types, Variables and Tokens.
- Channels.
- Choreographies.
- Activities and Ordering Structures.
- Workunits.

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 $N = (P, T, F, \alpha, \beta, \pi)$.

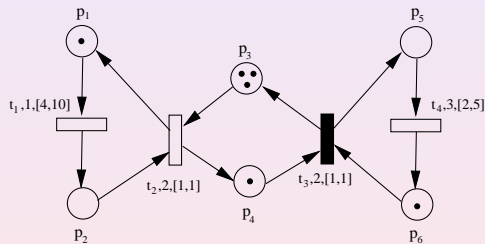
P	Finite set of <i>places</i>
T	Finite set of <i>transitions</i> ($T = T_1 \cup T_2$)
F	Flow relation ($F \subseteq (P \times T) \cup (T \times P)$)
$\alpha : T \rightarrow \mathbb{N}$	Earliest Static Firing Time
$\beta : T \rightarrow \mathbb{N} \cup \{\infty\}$	Latest Static Firing Time
$\pi : T \rightarrow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



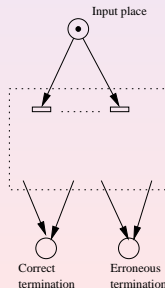
Relative Time Bounds	
t_1	[3,9]
t_2	-----
t_3	[0,0]
t_4	-----

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

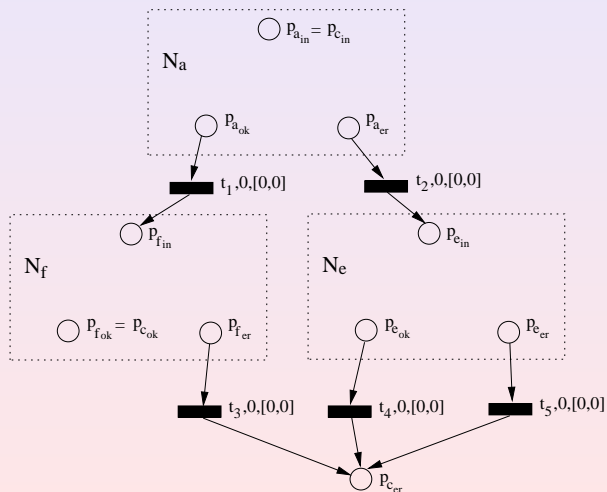
- There is one initial place which activates the PTPN when it is marked.
- There are two exit places: *correct* and *erroneous*. Only one of them can be finally marked.



PTPN SEMANTICS

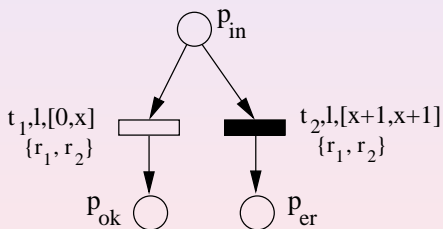
- Some elements of WS-CDL do not require a translation: RoleTypes, RelationshipTypes, ParticipantTypes, ChannelTypes and InformationTypes.
- Variables in general are not considered.
- Date and Time variables used to delay the execution are considered.
- Only a root choreography is considered.
- Activities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

CHOREOGRAPHIES

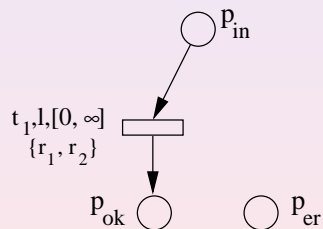


BASIC ACTIVITIES

Interaction activities:



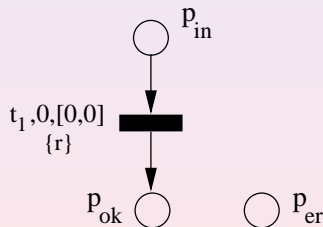
(a) With time-out



(b) Without time-out

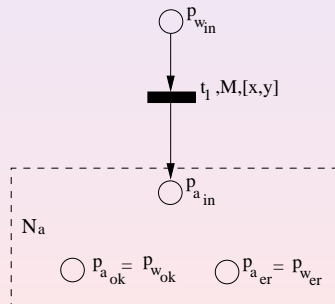
BASIC ACTIVITIES

Assign, Noaction and Silent activities:



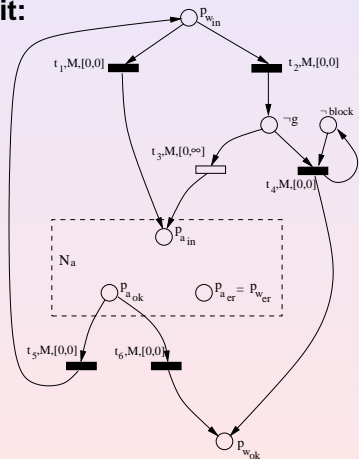
WORKUNITS

Delayed Workunit:



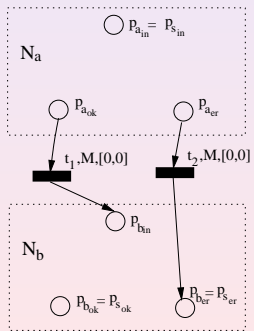
WORKUNITS

General Workunit:



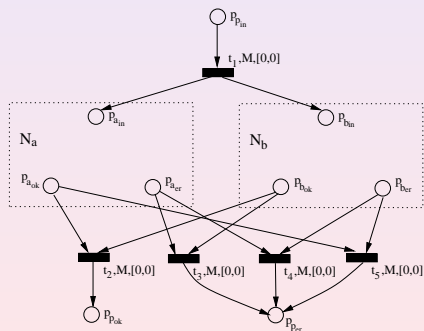
ORDERING STRUCTURES

Sequence:



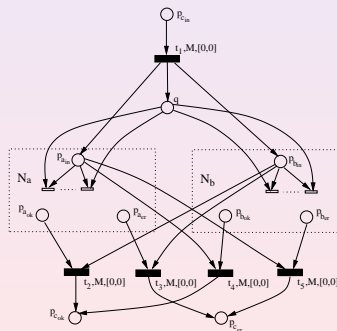
ORDERING STRUCTURES

Parallel:



ORDERING STRUCTURES

Choice without general guarded workunits:

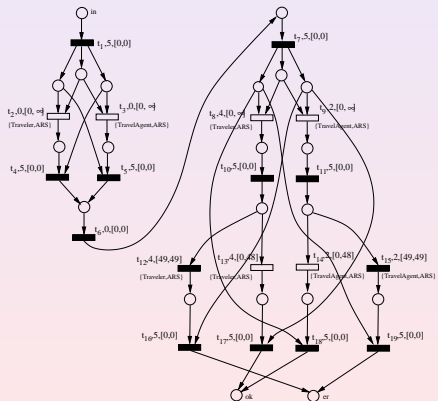


CASE STUDY

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.