

Modeling Communication Behaviour of Mobile Applications

André Köhler

University of Leipzig, Department of Informatics

Chair for Applied Telematics / e-Business

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Mobile Business Process

- (1) Employees are involved who execute their tasks at (geographically) different locations.
- (2) The exact location for the task execution is often known just shortly before the beginning of the task.
- (3) This uncertainty is determined by external factors and is therewith not fully influenced by the employee.

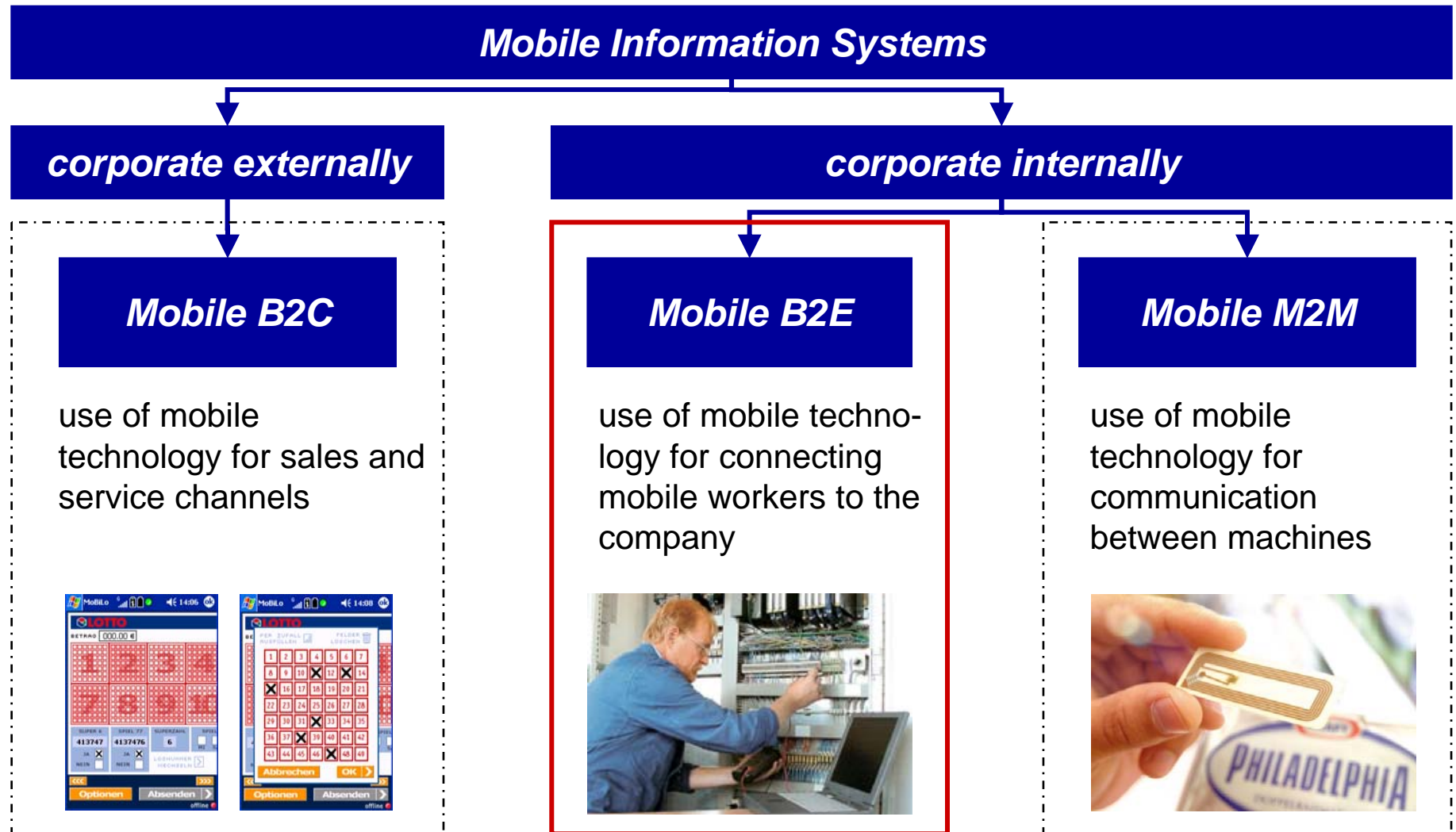
→ **task-driven mobility**

The task to solve causes the mobility of the mobile worker. He needs to move to different locations because of distributed resources that he needs for the task completion.

→ **use of IT**

... is in most of the cases a reasonable extension but often a requirement for the completion of the mobile process.

Mobile Information Systems



Challenges of Mobile Applications

Within the development and the use of mobile applications several challenges occur compared to stationary used applications:

1. Emergence of costs through fees for the mobile networks use.

- identifying critical parts of the application or business process with high transactional costs → reducing transmitted data volume

2. Insufficient performance of the application through small bandwidth.

- identifying critical parts of the application or business process with high transactional costs → reducing transmitted data volume

3. Unstable qualities of mobile network at point of action.

- dialog-specific requirements for bandwidth, transaction costs, response times for dynamic seamless roaming

Solution of the Outlined Problems

1. Creation of an application model focusing on the transmitted data volume for each process step.
 2. Simulation of the applications communication behaviour.
 3. Evaluation of the simulation results.
 4. Adjusting the application according to simulation results.
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- The simulation can be done with coloured petri nets (CPN).
 - A simple notation for the creation of the application model is needed in order to hide the complexity of CPN.
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- This introduction of the notation and the simulation process is limited to browser-based applications.

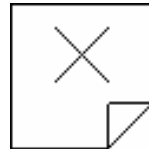
Notation Elements for Web-Based Systems

system actions

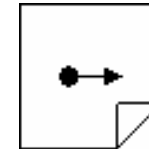


request/
response-
sequence

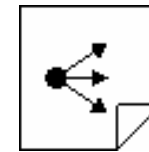
system states



process-
end



„state“ with one
possible following
action



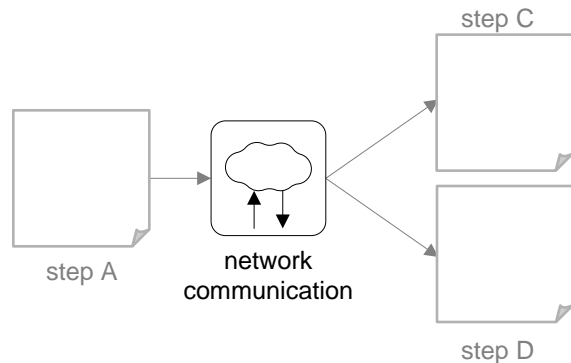
„state“ with multiple
possible following
actions

modeling rules

- a. all predecessors and successors of a *system action* must be *system states*
- b. all predecessors and successors of a *system state* must be *system actions*

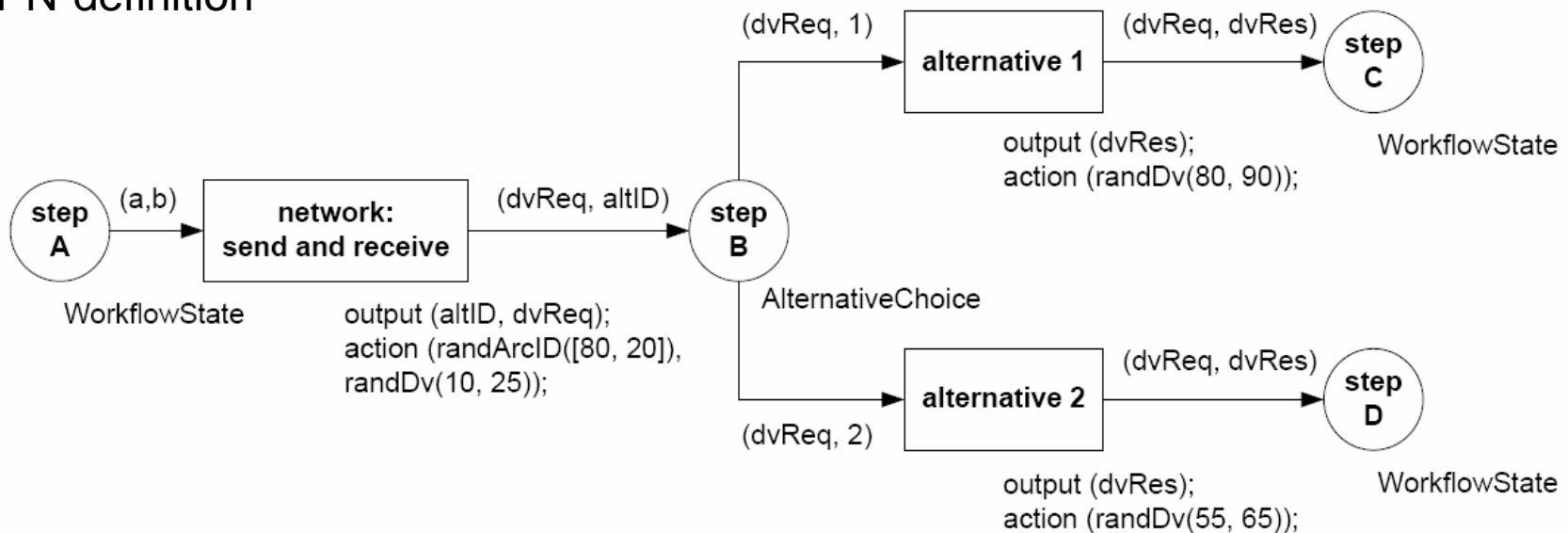
HTTP request/response-sequence

notation element

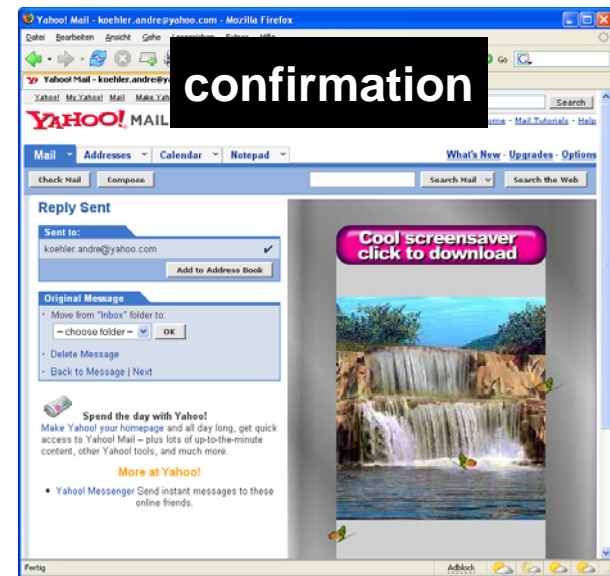
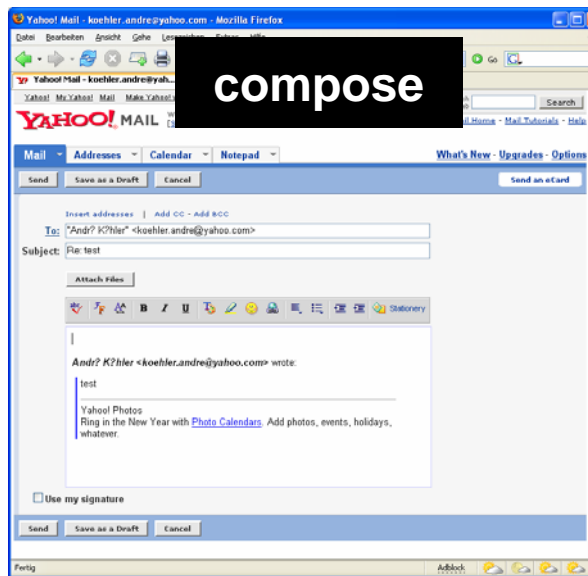
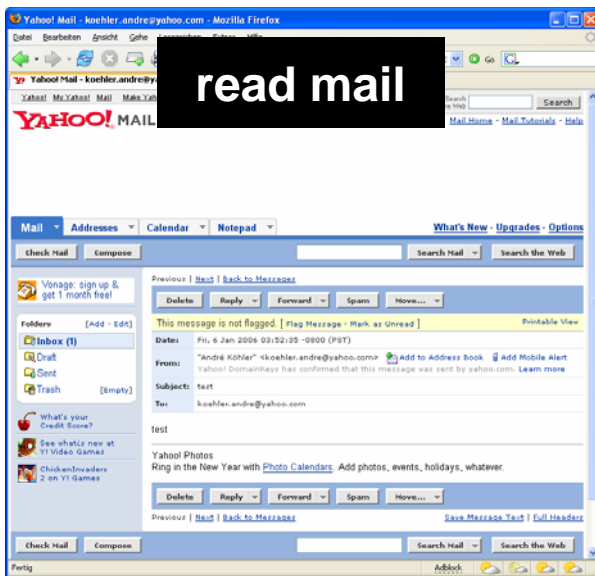
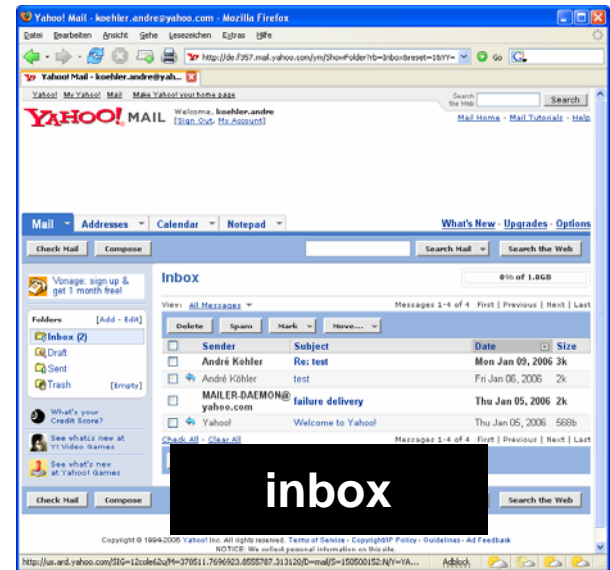
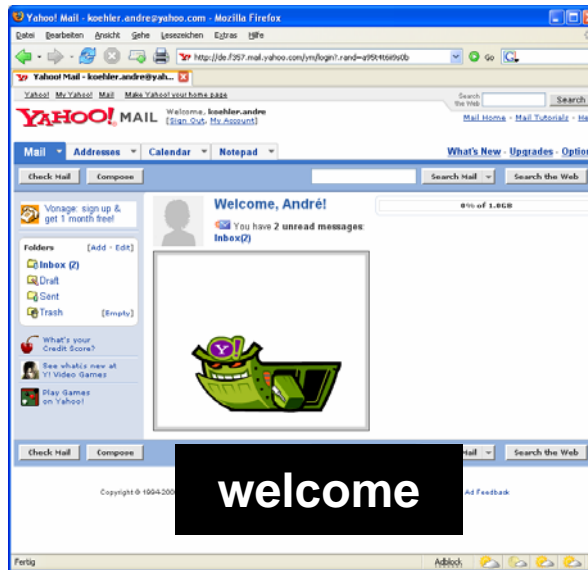
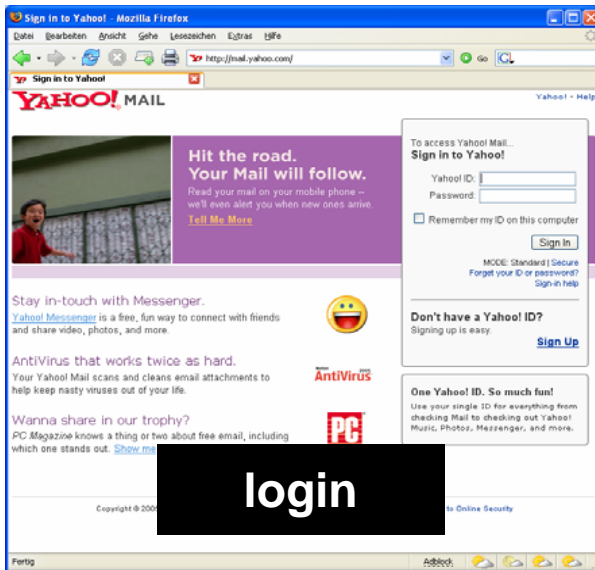


Name	network communication			
Request DV Min	10 kb			
Request DV Max	25 kb			
Alternatives	ID	Probability	Response DV Min	Response DV Max
	1	80%	80 kb	90 kb
	2	20%	55 kb	65 kb

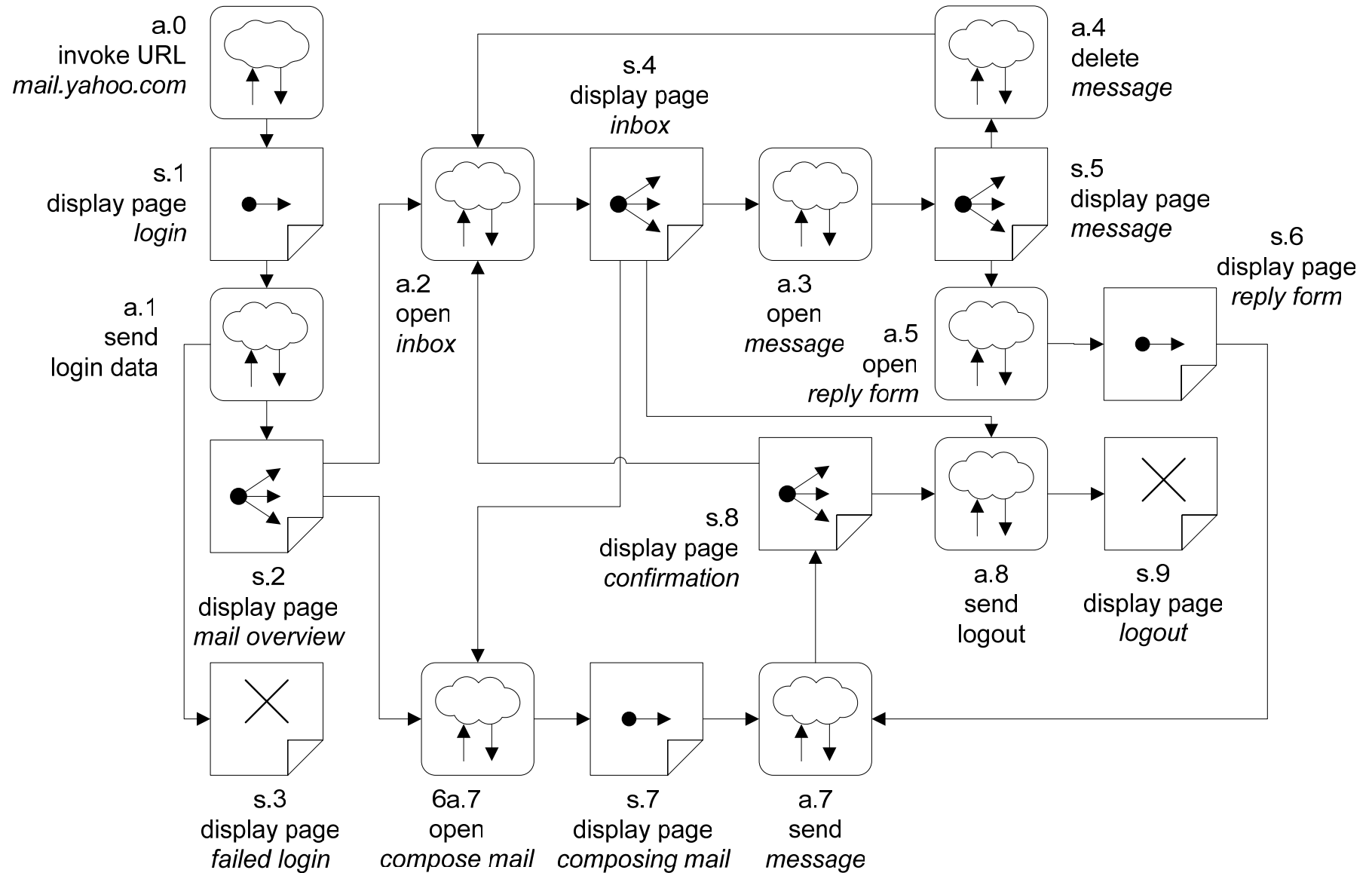
CPN-definition



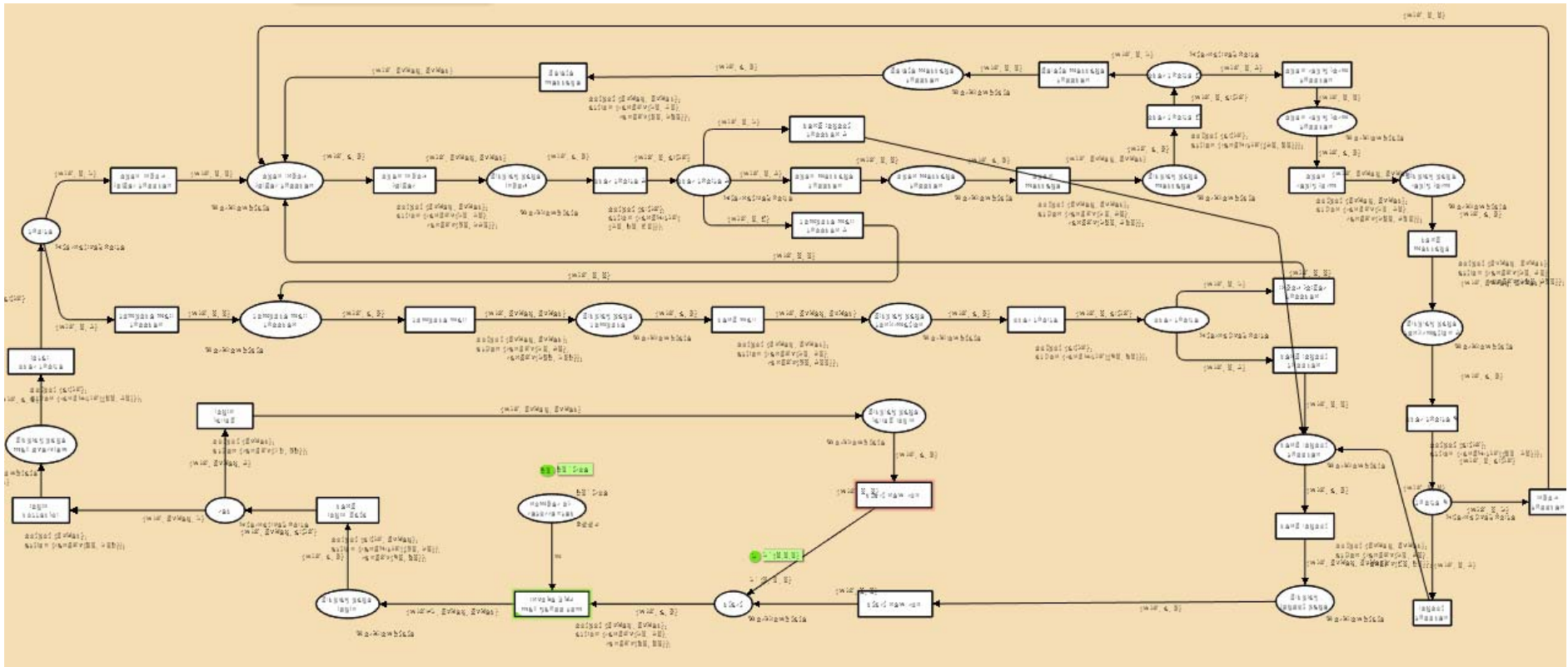
Example: yahoo!Mail I



Example: yahoo!Mail II



Example: yahoo!Mail III



Simulation Results: Response Time

Simulation Results

Transition	Σ Token	GPRS (15 kb/s)			UMTS (100 kb/s)			WLAN (500 kb/s)			custom profile (20 kb/s)		
		t ≤ 2s	2s < t ≤ 5s	t > 5s	t ≤ 2s	2s < t ≤ 5s	t > 5s	t ≤ 2s	2s < t ≤ 5s	t > 5s	t ≤ 2s	2s < t ≤ 5s	t > 5s
invoke URL mail	50	0	3	47	50	0	0	50	0	0	0	50	0
send login data	50	0	50	0	50	0	0	50	0	0	2	48	0
login succesful	48	0	0	48	48	0	0	48	0	0	0	0	48
open inbox folder	74	0	0	74	74	0	0	74	0	0	0	0	74
open message	33	0	0	33	2	31	0	33	0	0	0	0	33
open reply form	30	0	0	30	4	26	0	30	0	0	0	0	30
send message	30	0	0	30	12	18	0	30	0	0	0	0	30
send logout	48	0	48	0	48	0	0	48	0	0	1	47	0
compose mail	35	0	0	35	20	15	0	35	0	0	0	0	35
send mail	35	0	0	35	30	5	0	35	0	0	0	0	35
delete message	3	0	0	3	3	0	0	3	0	0	0	1	2
login failed	2	0	0	2	2	0	0	2	0	0	0	0	2

target response time (s)

maximum response time (s)

bandwidth of custom profile (kb/s)

CPN simulation report

Plan Database: Overview

Mobile Network Price Plan Database

Overview

[Add new plan](#)

Provider ^Δ	Plan Name		
T-Mobile	Data Connect + Data 30	Edit	Delete
T-Mobile	Data Connect + Data 5	Edit	Delete
T-Mobile	Data Connect + Data 150	Edit	Delete
T-Mobile	Data Connect + Data Time 120	Edit	Delete
T-Mobile	Data Connect + Data Time 600	Edit	Delete
T-Mobile	Data Connect + web'n'walk XL	Edit	Delete
Vodafone	Time L	Edit	Delete
Vodafone	Time XL	Edit	Delete
Vodafone	Time XXL	Edit	Delete
Vodafone	Time XXL 100	Edit	Delete
Vodafone	Volume L	Edit	Delete
Vodafone	Volume XL	Edit	Delete
Vodafone	Volume XXL	Edit	Delete
Vodafone	Volume XXL 1000	Edit	Delete
Vodafone	Custom Vodafone Plan + Volume by Call (WAP and Web)	Edit	Delete
Vodafone	Custom D2 Plan + D2 Volume by Call Web	Edit	Delete
Vodafone	Custom D2 Plan + D2 Volume by Call WAP	Edit	Delete
Vodafone	Custom BusinessData Plan + CSD/HSCSD for national fixed line connections	Edit	Delete
E-Plus	Online Flat 150	Edit	Delete
E-Plus	Online Flatrate Tarif	Edit	Delete

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Plan Database: View Plan

Mobile Network Price Plan Database

Edit/View Plan

[Back to List](#)

Provider	T-Mobile <input type="button" value="v"/>
Plan Name	Data Connect + web'n'walk XL
Billing Cycle (months)	1
Minimum Turnover per Billing Cycle* (EUR)	0
Base Charge per Billing Cycle* (EUR)	40

* incl. VAT

Billing Model

[Add New Billing Detail](#)

Network	Accounting Basis	Pulse (s or kb)	Charge Basis (s or kb)	Charge* (EUR)	Begin (s or kb)	End (s or kb)	New Pulse after Disconnection**	Increase Pulse Count after Period (s)		
T-Mobile GPRS EDGE UMTS HSDPA	time (s)	86400	86400	1	0	0	no	0	Edit	Delete
T-Mobile GPRS EDGE UMTS HSDPA	volume (kb)	100	100	0	0	5242880	yes	0	Edit	Delete
T-Mobile GPRS EDGE UMTS HSDPA	volume (kb)	100	1024	1	5242881	0	yes	0	Edit	Delete
T-Mobile WLAN	time (s)	60	60	0	0	720000	yes	0	Edit	Delete
T-Mobile WLAN	time (s)	60	60	0.255	720001	0	yes	0	Edit	Delete

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* national calls, incl. VAT

** no implies sustaining recent pulse offline

Simulation Results: Costs

sequence name	sequence	recurrences per month	average data volume (kb)	total data volume (kb)
login and open inbox	a.0, a.1, a.2	60	317	100489
compose mail, send and return to inbox	a.6, a.7, a.2	100	450	202500
display mail, delete and return to inbox	a.3, a.4, a.2	150	460	211600
display mail, reply and return to inbox	a.3, a.5, a.7, a.2	80	720	518400
logout	a.8	60	55	3025
				1036014

provider	plan	base charge per month	charge (MB)	inclusive volume (kb)	total costs per month (EUR)
Vodafone	Volume L	9,86	1,86	30720	1835,88
Vodafone	Volume XL	34,8	1,28	204800	1073,82
Vodafone	Volume XXL	69,6	0,93	512000	545,51
Vodafone	Volume XXL 1000	104,4	0,58	1024000	111,20
T-Mobile	Data Connect + Data 5	10	3	5120	3030,20
T-Mobile	Data Connect + Data 30	15	1,9	30720	1880,29
T-Mobile	Data Connect + Data 150	35	1,3	153600	1155,25

Summary and Outlook

Summary

- With the introduced modeling notation the communication behaviour of mobile applications can be described.
- The formal basis of the notation is given through coloured petri nets.
- The simulation of the created model and the analysis of the simulation results allows the prediction of response times and occurring costs for mobile application.

Outlook

- Also thin-client and fat-client application with asynchronous communication should be considered.

André Köhler
University of Leipzig
Chair of Applied Telematics / e-Business
Klostergasse 3
04109 Leipzig, Germany

koehler@ebus.informatik.uni-leipzig.de