Telephony feature validation against eventuality properties and interaction detection based on a statistical analysis of the time to service

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Context Eventuality vs safety Validation against eventuality Conclusion	2
Summary	

- Context
- Eventuality and safety properties
- Validation against eventuality properties
- Conclusion and perspectives

ContextFIW'98Eventuality vs safetyOur propositionValidation against eventualityCCBS + RCBConclusion

FIW'98

- First FI detection contest : POTS + 12 features
 - Informal description
 - Chisel diagrams
- Our proposition
 - translate Chisel diagrams into synchronous programs
 - express safety properties
 - test to find safety violation with our testing tool

ContextFIW'98Eventuality vs safetyOur propositionValidation against eventualityCCBS + RCBConclusion

Our proposition : the tool



Validation against eventuality property (ICFI'05)

Context FIW'98 Eventuality vs safety Our proposition Validation against eventuality Conclusion

Our proposition : the tool



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Feature Interaction Definition

- Let F1 and F2 be two services
- Let P1 and P2 be the associated properties
- There is an **interaction** between F1 and F2 when :
 - F1 conforms to P1 and
 - F2 conforms to P2 and
 - (F1 & F2) NOT conforms to (P1 and P2)

ContextFIW'98Eventuality vs safetyOur propositionValidation against eventuality
ConclusionCCBS + RCB

Applicability

- Synchronous model : simple and expressive enough
- Testing : always applicable
- Safety property (~ 30)
 - "this bad behaviour should never occur when ..."
 - "this event should always occur when..."
- First Contest : 😳
- 2nd Contest : applicable

ContextFIW'98Eventuality vs safetyOur propositionValidation against eventualityCCBS + RCBConclusionC

CCBS+RCB and safety

- CCBS : Call Completion on Busy Subscriber
- Activation followed by Deactivation
- « always deactivation as soon as possible »
- RCB : Return Call on Busy
- CCBS and RCB together : interaction
- Not detected the with safety property ! ^(C)

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Call Completion on Busy Subscriber (CCBS) feature

- A is CCBS Subscriber
- A dials B number
- B is Busy
- A can dial CCBS code = CCBS activation
- When A and B both idle, CCBS calls A
- Then B is called (if idle)

CCBS invocation 10

• When B's phone ringing = CCBS deactivation

CCBS Context Eventuality vs safety RCB CCBS + RCB Validation against eventuality Conclusion Safety not enough

Return Call on Busy (RCB)

- B is RCB Subscriber
- A dials B number
- B is Busy
- Automatic RCB activation
- Automatic hob activities.
 When A and B both idle, RCB calls B RCB invocation
- Then A is called (if idle)

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When A's phone ringing = RCB deactivation

ContextCCBSEventuality vs safetyRCBValidation against eventualityCCBS + RCBConclusionSafety not enough

CCBS + RCB

- A is CCBS subscriber, B is RCB subscriber
- A dials B number, B is Busy
- Automatic RCB activation
- A can dial CCBS code = CCBS activation
- When A and B both idle,
 - CCBS calls A & RCB calls B
 - B is busy for CCBS, A is busy for RCB
- Interaction



ContextCCBSEventuality vs safetyRCBValidation against eventualityCCBS + RCBConclusionSafety not enough

CCBS+RCB and safety

- RCB and CCBS : simultaneous invocations
- CCBS deactivation is not possible
 B is always busy during CCBS invocation
- Safety = "CCBS deactivation when A and B connected"
 - Situation "when A and B connected" never occurs
 - Property always true
- CCBS activation is eventually followed by a deactivation

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CCBS+RCB validation

Expected property

activation \sim deactivation

- Test against eventuality property ?
 - if no deactivation « after a long time »
 - due to environment behaviour ?
 - due to interaction ?

General problem

- S = a program
- S carries out a service
 - user makes a request, S has to respond
 - time to response depends on the environment behaviour
- How to show (with test) that S satisfies
 always (request ~ response)
- If S has not provided response yet :
 Solution by the environment or due to a problem ?

Detection of an interaction (CCBS+RCB)

- TTS = time elapsed between activation and deactivation
- Synchronous context => number of tick
- Feature alone
 - time distribution => probabilistic law
- Both features
 - same probabilistic law for elapsed time distribution?
 - Yes = no interaction
 - No = may be interaction

Experiment

- 4 situations
 - CCBS
 - CCBS+RCB v1, +RCB v2, RCB v3
- Testing with our random testing tool
 - equi-probable event distribution
 - long simulations (100 000 steps)
 - shortest activation-deactivation = 4 steps



CCBS alone : time distribution



CCBS + RCB v1 : time distribution

No distribution law

Livelock

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Validation against eventuality property (ICFI'05)



CCBS + RCB v2 : time distribution



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Validation against eventuality property (I

(ICFI'05)



CCBS + RCB v3 : time distribution



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Validation against eventuality property

Conclusion & perspectives

- Testing against eventuality
 - Service : request followed by response
 - Response depends on environment behaviour
 - TTS distribution comparison
- Problem
 - Need to have 2 distributions

Conclusion & perspectives

- Feature Interaction
 - "Non conform" behaviours
 - · Detected with safety
 - Delay in execution
 - Detected with eventuality
- Feature alone
 - Validation against eventuality
 - Estimation of the law ?

Conclusion & perspectives

Specific case study

- CCBS and RCB
- see other examples
- Statistical testing tool
 - environment behaviour => statistical law

Questions ?



Context

- Telecommunication features
 - Plain Old Telephone Service (POTS)
 - Call Forwarding, Screening features, ...
- Features may interact :



Our previous work

- Approach for Feature Interaction detection
 - to model network and features with synchronous approach (Lustre)
 - to express safety properties (A \Rightarrow B)
 - to test to find safety violation (A $\land \neg B$)
- Application of the approach: FIW contest
 - 12 features, 30 safety properties
 - 72 pairs of feature, ~80 interactions found

Statistical Analysis

- CCBS alone
 - Gamma-Gamma law (4.31228,02219956)
- CCBS + RCB v1
 - No distribution law
- CCBS + RCB v2
 - Gamma-Gamma law (2.501,0.09398237)
- CCBS + RCB v3
 - Gamma-Gamma law (1.892469,0.043162)