Communication:
A Specific High-level View and Modeling Approach

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Background

- **NexComm 2013**
- Definition of "Communication":
  - *WordNet:*
    "the activity of communicating (*syn*)"
    Communicate: "transmit information"
  - *Webster Dictionary:*
    "an act or instance of transmitting information",
    "an exchange of information"
  - *Merriam Webster's Collegiate Thesaurus:*
    "interchange of thoughts or opinions through shared symbols"

Outline

- Background
- Introduction
- AI theories underpinning discourse modeling
- Other theories underpinning discourse modeling
- Interaction design based on discourse modeling
- Sketch of automated user-interface generation
- Including machine-machine communication
- Conclusion

Introduction

- Focus on discourses in the sense of dialogues
- Communicative interaction between human and machine
- How about machine–machine communication?
- A unified view

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Scripts

- Schank and Abelson
- Script: structure that describes appropriate sequences of events in a particular context
- Handles well-known everyday situations
- Predetermined and stereotyped sequence of actions

Scripts – Restaurant script example

Sketch of stereotypical sequence of actions in (U.S.) restaurant:

A customer enters a restaurant and waits to be seated.

A waiter guides the customer to an empty table and hands over a menu.

The customer studies the food list in the menu and chooses something.

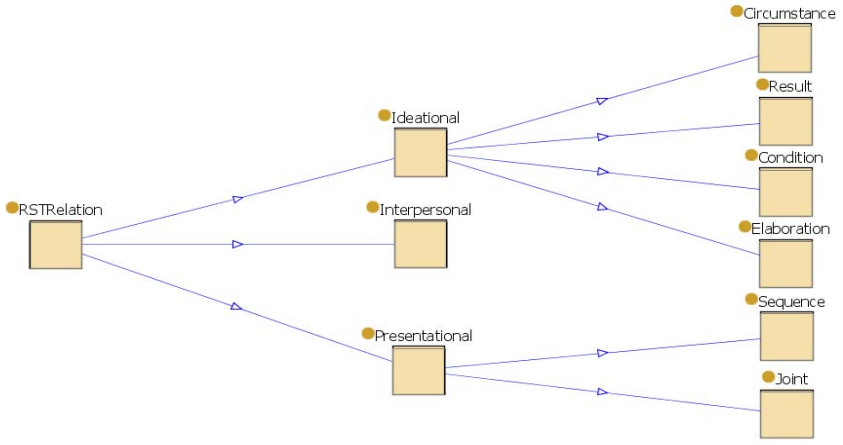
The waiter comes to the table and takes the order.

…

Rhetorical Structure Theory (RST)

- Mann and Thompson
- Linguistic theory
- Internal relationships among text portions and associated constraints and effects
- Relationships in a text are organized in a tree structure
- Rhetorical relations associated with non-leaf nodes, and text portions with leaf nodes

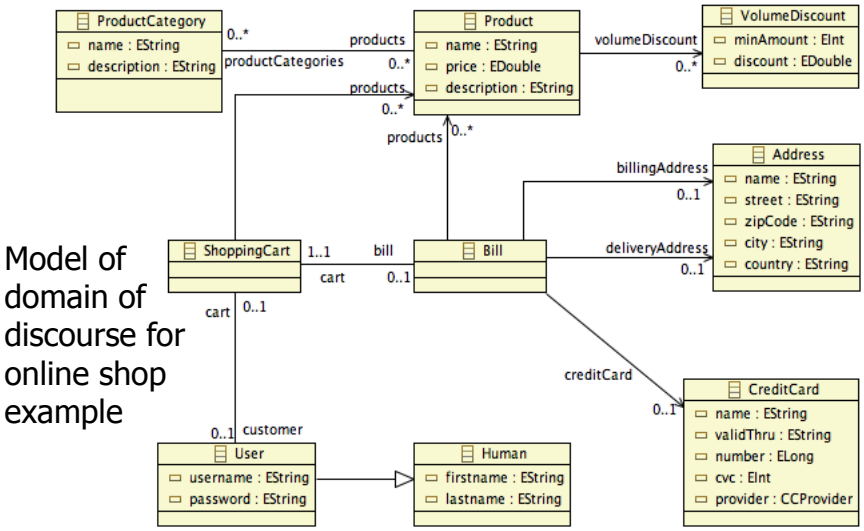
RST Taxonomy (selection)



Ontologies

- Tom Gruber
- Actually, the old Greeks
- Domain models
- Conceptualizations of a domain
- Often using taxonomies and object-based ideas
- Ontology languages based on knowledge-representation theories
- E.g., OWL based on description logic

Ontologies



Model of domain of discourse for online shop example

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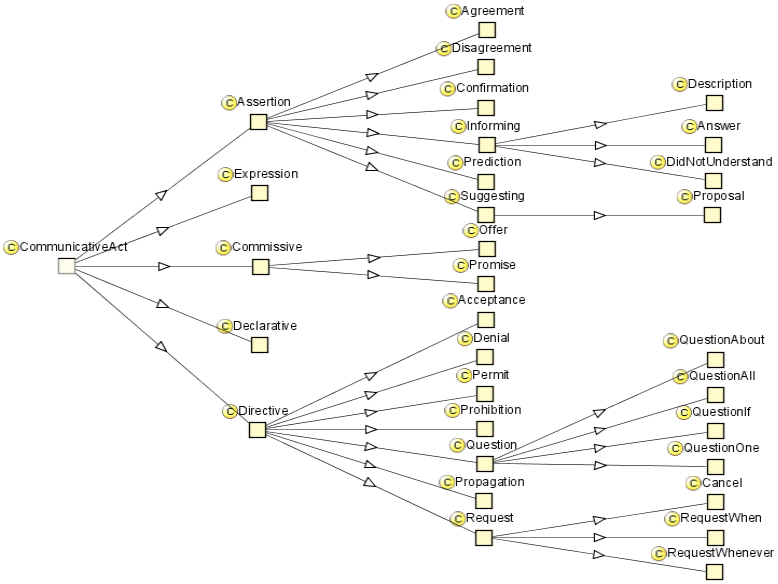
Speech acts

- John R. Searle
- Theory from philosophy of language
- Human speech also used to do something with intention — to act
- "Speaking a language is performing speech acts, act such as making statements, giving commands, asking questions and so on"
- Speech acts: basic units of language communication
- Communicative acts: abstraction from speech

Communicative Acts Taxonomy (selection)



Conversation Analysis

- Harvey Sacks; Luff, Gilbert and Frohlich
- Theory from sociology
- Focus on sequences of naturally-occurring talk "turns"
- To detect patterns that are specific to human oral communication
- Adjacency pair: e.g., a question should have a related answer
- Inserted sequence: subordinate interactions

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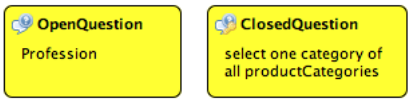
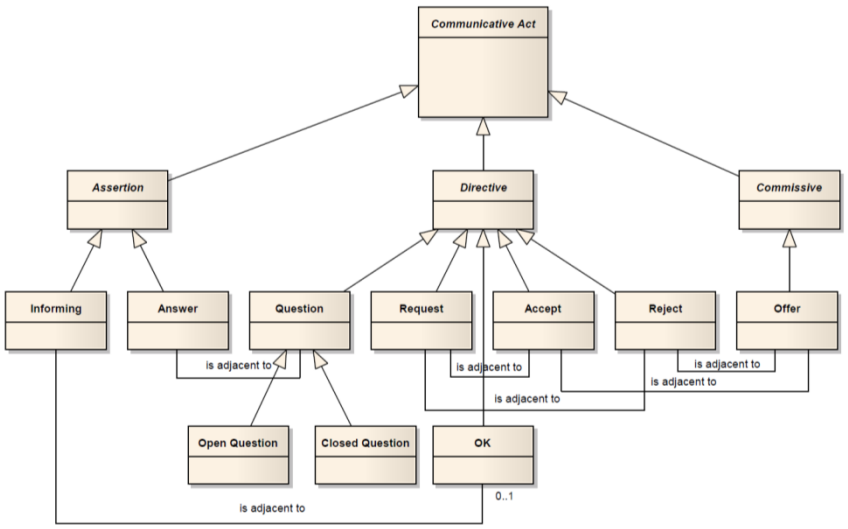
Communicative Acts – Open & Closed Question

- Open Questions enable asking for a particular type of information, respectively, an instance of a domain class.
- Closed Questions restrict the possible answer to a list of provided domain instances to choose from.

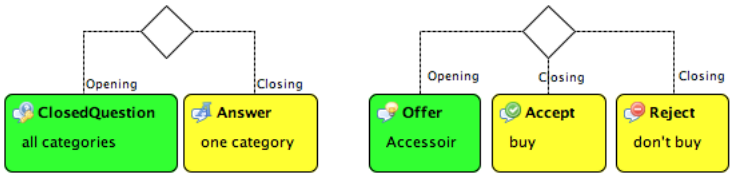


Communicative Acts Taxonomy

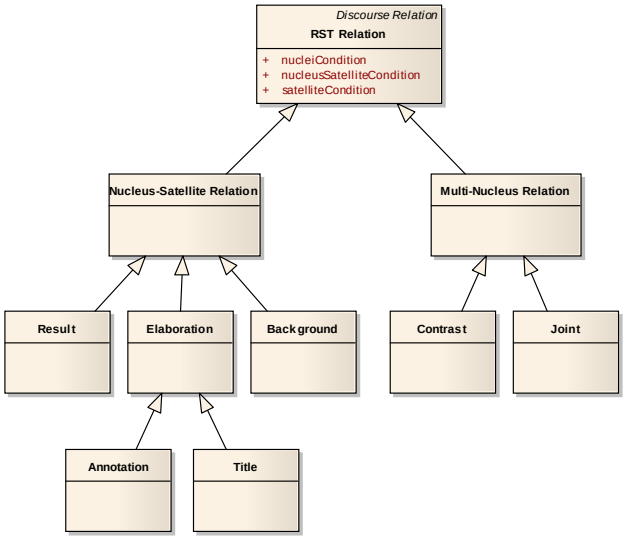


Adjacency Pair

- Relates an initial communicative act with one subsequent communicative act or two alternative subsequent communicative acts.
- Typical adjacency pairs of communicative acts are:
  - ClosedQuestion–Answer, OpenQuestion–Answer
  - Offer–Accept, Offer–Reject
  - Request–Accept, Request–Reject

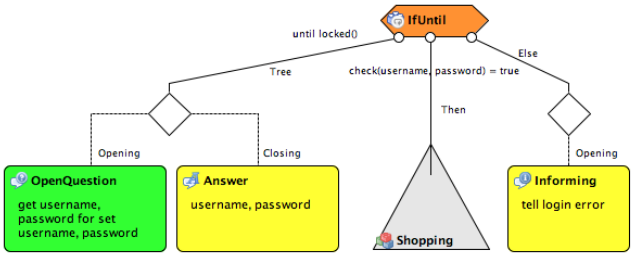


Taxonomy of "Rhetorical" relations

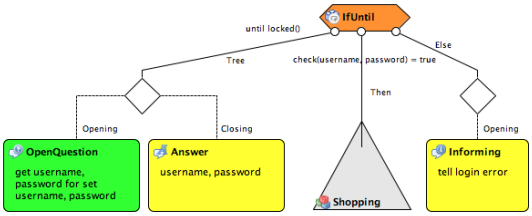


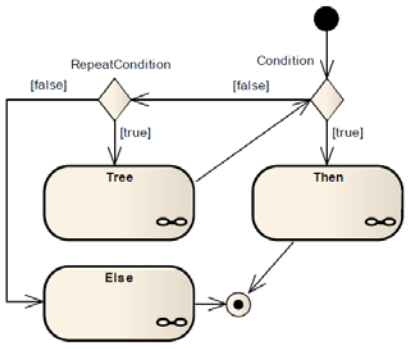
Procedural construct – IfUntil

- If-statement combined with a conditional loop
- Utterance of the <Then> subtree depends on successful execution of the related Condition.
- Repetition of the <Tree> branch until Condition becomes fulfilled, while RepeatCondition is fulfilled

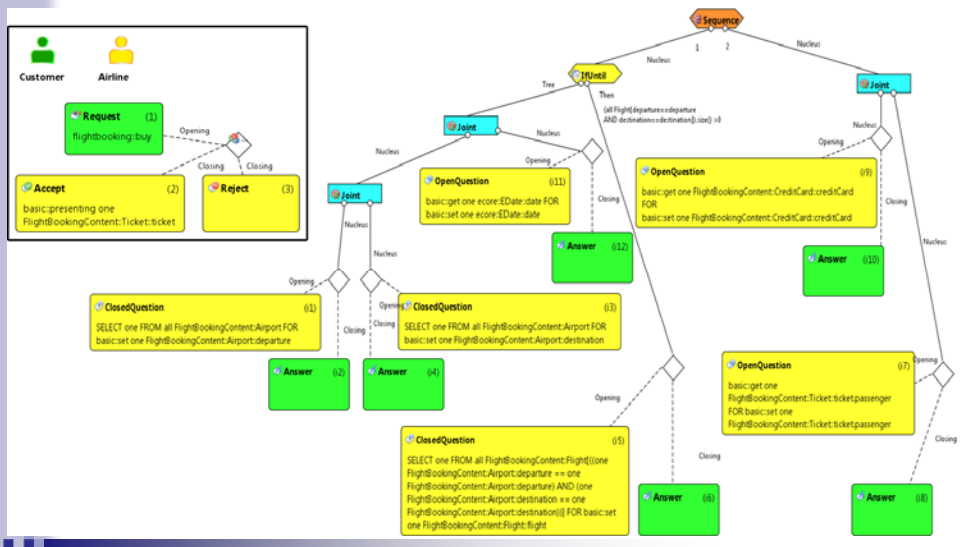


Procedural construct – IfUntil (cont.)





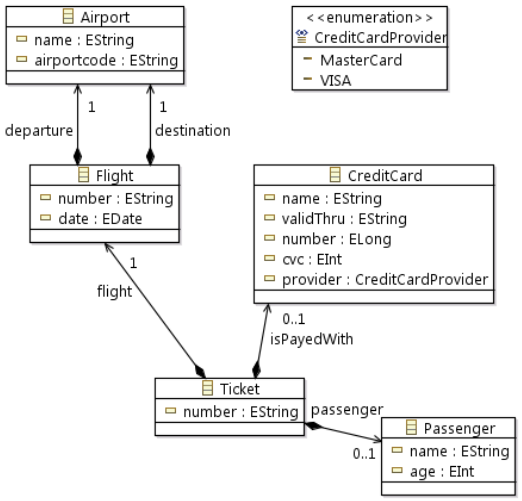
Flight Booking Discourse Model



Domain representation

- Speech act usually talks about something in the domain of discourse
- Part of model of the domain

Flight Booking Domain-of-Discourse Model



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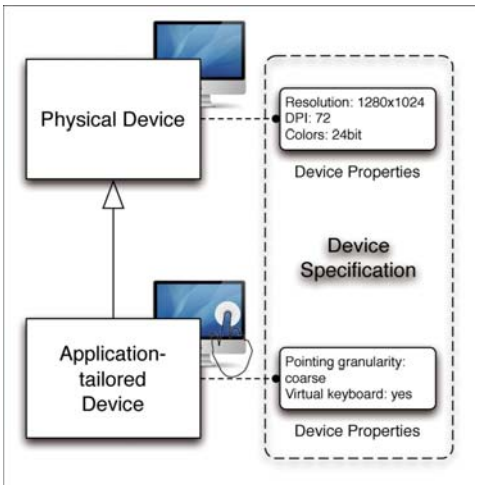
Rendering of Final User Interfaces

- Automated generation of final (multimodal) UIs
- Generation of GUIs
  - Generation of Structural UI Model
  - Optimization (for Smartphones)
  - Generation of Behavioral UI Model
  - Weaving of Structural and Behavioral Models
- Even for multiple platforms

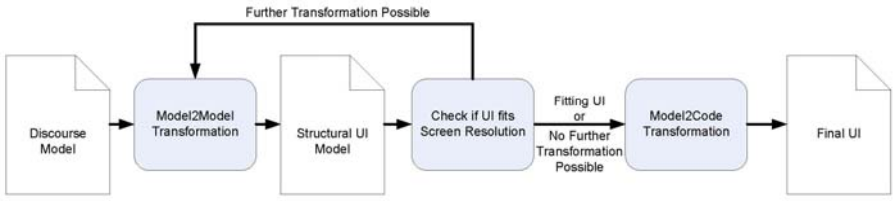
Generation of Structural UI Model – Devices

- Generation according to device specifications
- Application-tailored device specifications in addition to physical ones



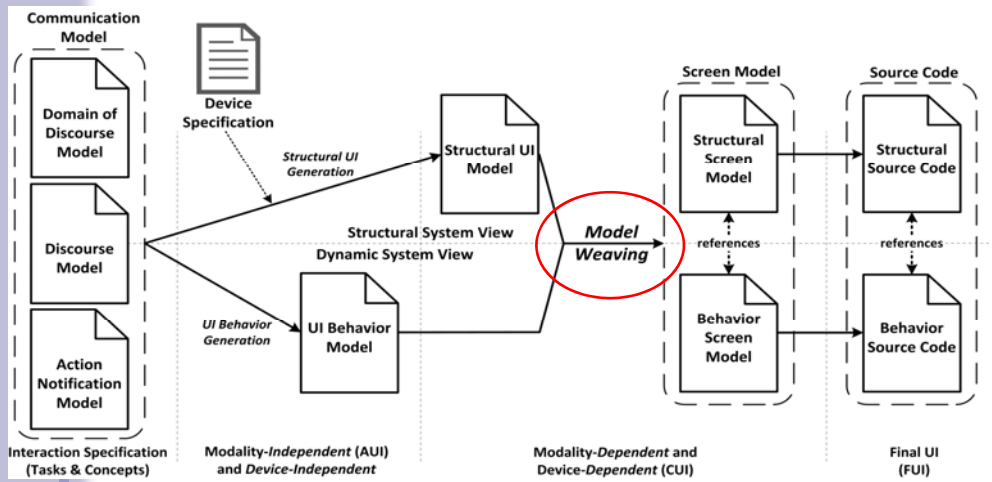
Optimization for Smartphones

- Objectives:
  - Maximum use of the available space
  - Minimum amount of navigation clicks, and
  - Minimum scrolling (except list widgets)
- Heuristic search for optimization (Branch & Bound)

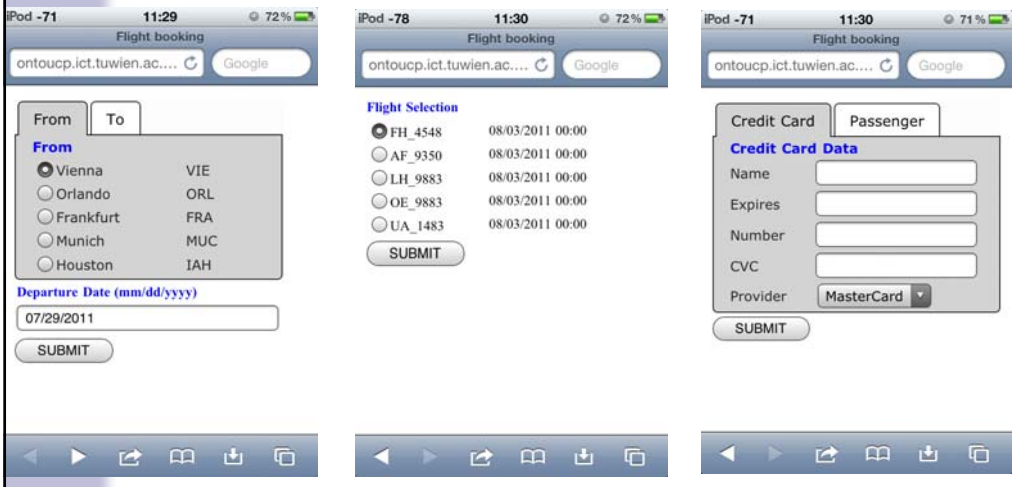


Weaving of Structural and Behavioral Models

- Different levels of abstraction



Flight Booking Rendered for iPod Touch



Examples of Final User Interfaces – Robots

- EU-funded research project CommRob: http://www.commrob.eu
- Semi-autonomous Robot Carts
- Specific transformation rules for a given GUI design
- Touchscreen

Final UI for Finger-based Touchscreen

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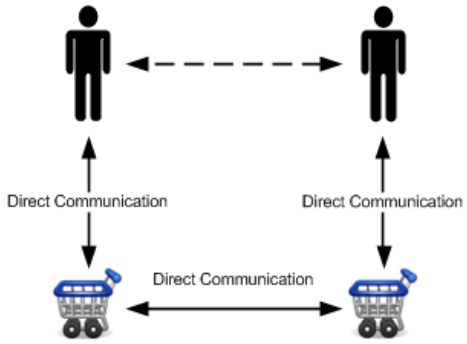
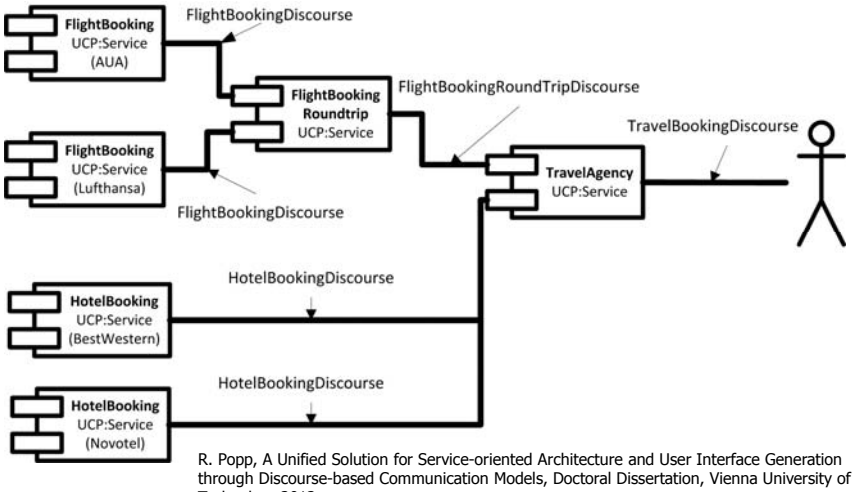
Shared Shopping Scenario

- Two users of robot carts agreed to shop cooperatively together.
- Both users check out a cart each.
- The two users enter all items of their shopping list simultaneously via the GUI of their assigned cart.
- They move to products and put them into their carts and finally check out.

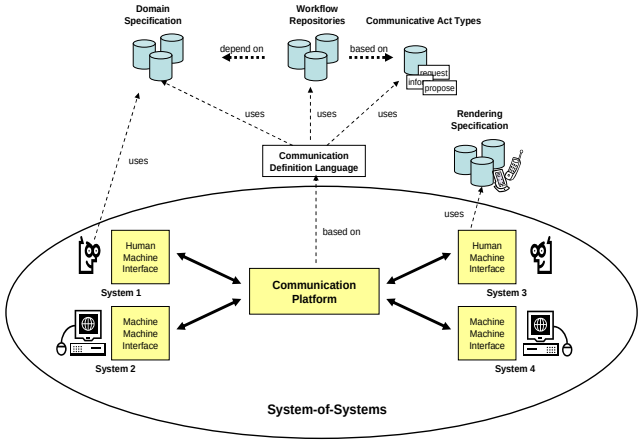


SOA Service Composition (TravelAgency)



R. Popp, A Unified Solution for Service-oriented Architecture and User Interface Generation through Discourse-based Communication Models, Doctoral Dissertation, Vienna University of Technology,2012.

Unified Communication Platform



http://ucp.ict.tuwien.ac.at

Conclusion

- Simple flight-booking GUI
- Optimized for Smartphones, see http://ontoucp.ict.tuwien.ac.at/UI/FlightBooking
- This works comparably much better for smaller screens!?
- High-level communication between robots / machines as well
- Unified approach to high-level communication
- The "next" wave of communication? – **NexComm**

Thank you for your attention!

Optimized for Smartphones, see

http://ontoucp.ict.tuwien.ac.at/UI/FlightBooking

Literature

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Selected work of this tutorial presenter

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