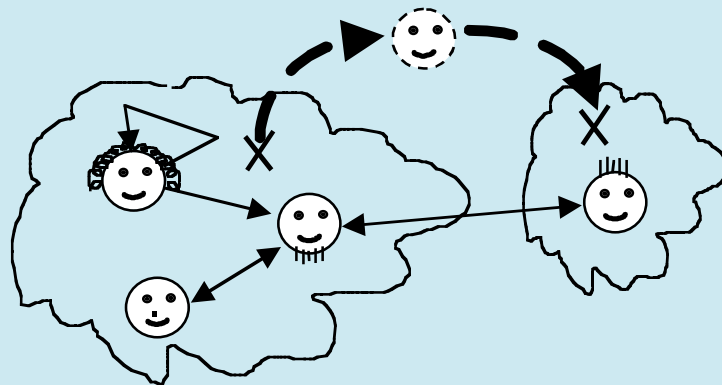


Specifying agent interactions using UML:

What does this mean for current and future FIPA standards?



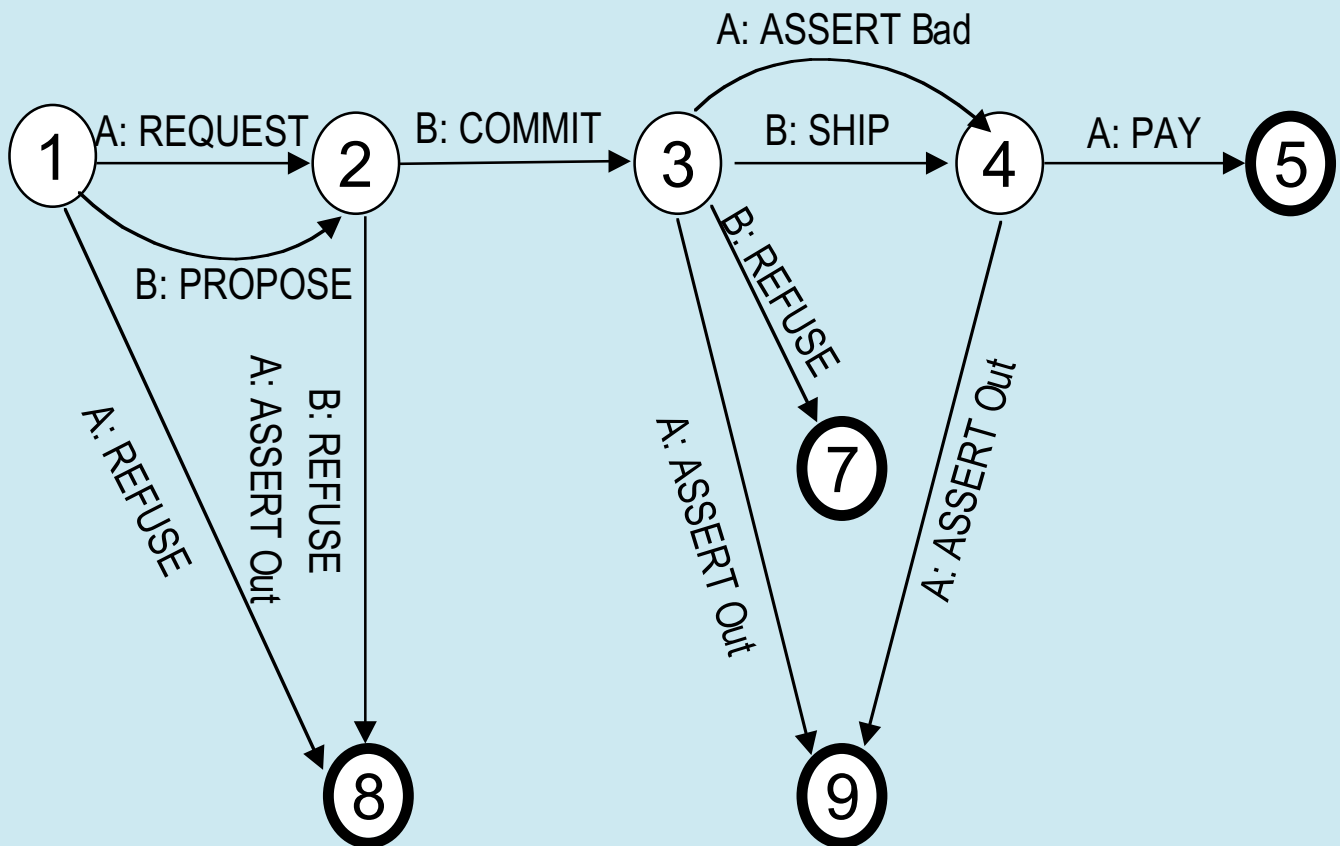
James J. Odell

www.jamesodell.com

AN AGENT CONVERSATION

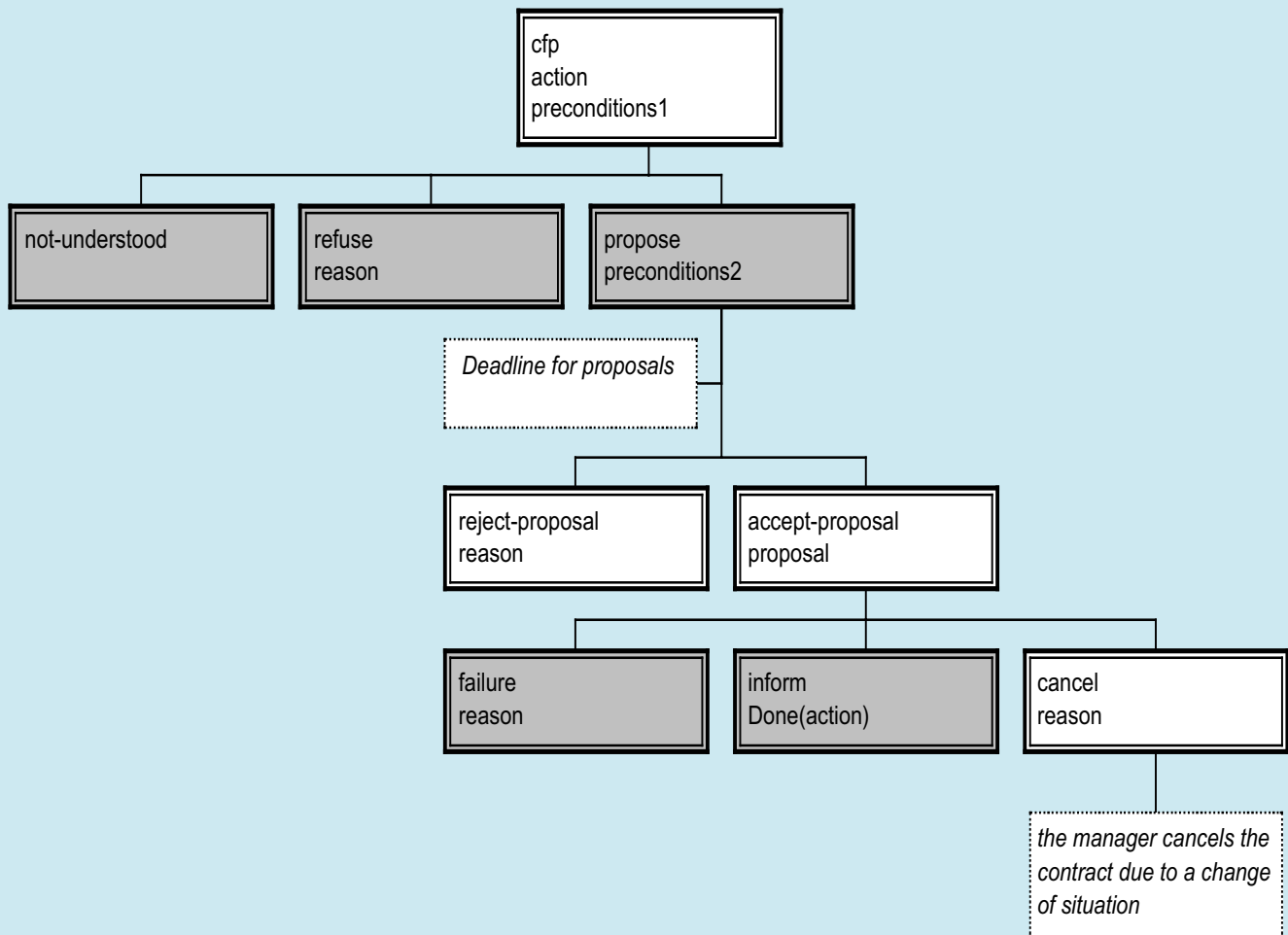
Seq	Sndr	Rcvr	Utterance	Rspnds to	Replies to	Re-solves	Com-pletes
1.	A	B,C,D	REQUEST: Please send me 50 widgets at your catalog price by next Thursday.				
2.	B	C	QUESTION: Are you bidding on A's RFQ?	1			
3.	C	B	INFORM: Yes, I am.	2	2	2	
4.	B	A	REFUSE	3	1	1	
5.	C	A	PROPOSE (INFORM + REQUEST): How about 40 widgets at catalog price by next Friday?	1	1		
6.	A	C	REQUEST: Please send me 40 widgets at catalog price by next Friday.	5	5	5	
7.	C	A	COMMIT: I plan to send you 40 widgets at catalog price by next Friday.	6	6	6	
8.	D	A	COMMIT: I plan to send you 50 widgets at catalog price by next Thursday.	1	1	1	
9.	A	C	ASSERT: I've found a better supplier, and am not relying on your COMMIT.	7,8	7		
10.	C	A	REFUSE: I'm abandoning my COMMIT.	9	9		7
11.	D	A	SHIP: Here are your widgets. Please pay me.	1	1		8
12.	A	D	ASSERT + REQUEST: You're five short. Please send the difference.	11	11		
13.	D	A	SHIP: Here are five more widgets. Please pay me.	12	12	12	
14.	A	D	PAY	13	13	13	

WINOGRAD-FLORES VERSION OF AN AGENT INTERACTION PROTOCOL (AIP)



After Smith and Cohen 1995

1997 FIPA-STYLE AGENT INTERACTION PROTOCOL (AIP)

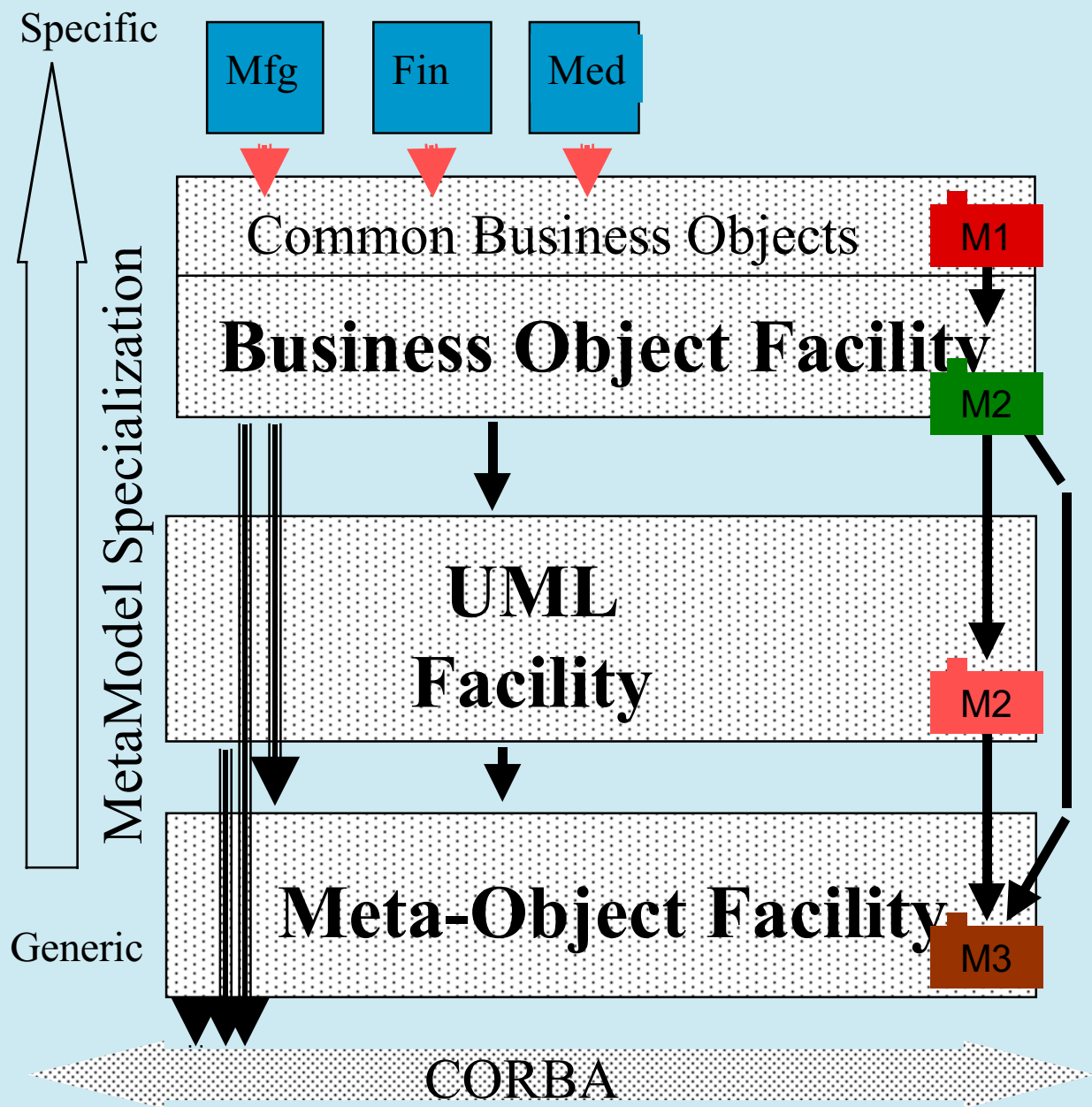


FIPA 97 Specification, Version 2.0, Part 2, Agent Communication Language

AGENTS STANDARDIZATION AND AGENT UML (AUML)

- ❑ **FIPA (Federated Intelligent Physical Agents)** has been working to develop and promote standardization in the area of agent interoperability since 1996. It has an on-going work program, meeting around the globe on a quarterly basis, with excess of 50 member organizations. (www.fipa.org)
- ❑ **OMG Agents Working Group** recommends standards for agent technology where appropriate—particularly the OMG's Object Management Architecture (OMA). (www.omg.org)

MOF/ADF/BOF ARCHITECTURE



UML DIAGRAMS

Dynamic Diagrams

- Sequence diagrams
- Collaboration diagrams
- Activity diagrams
- Statechart
- Deployment diagrams
- Use Case diagrams

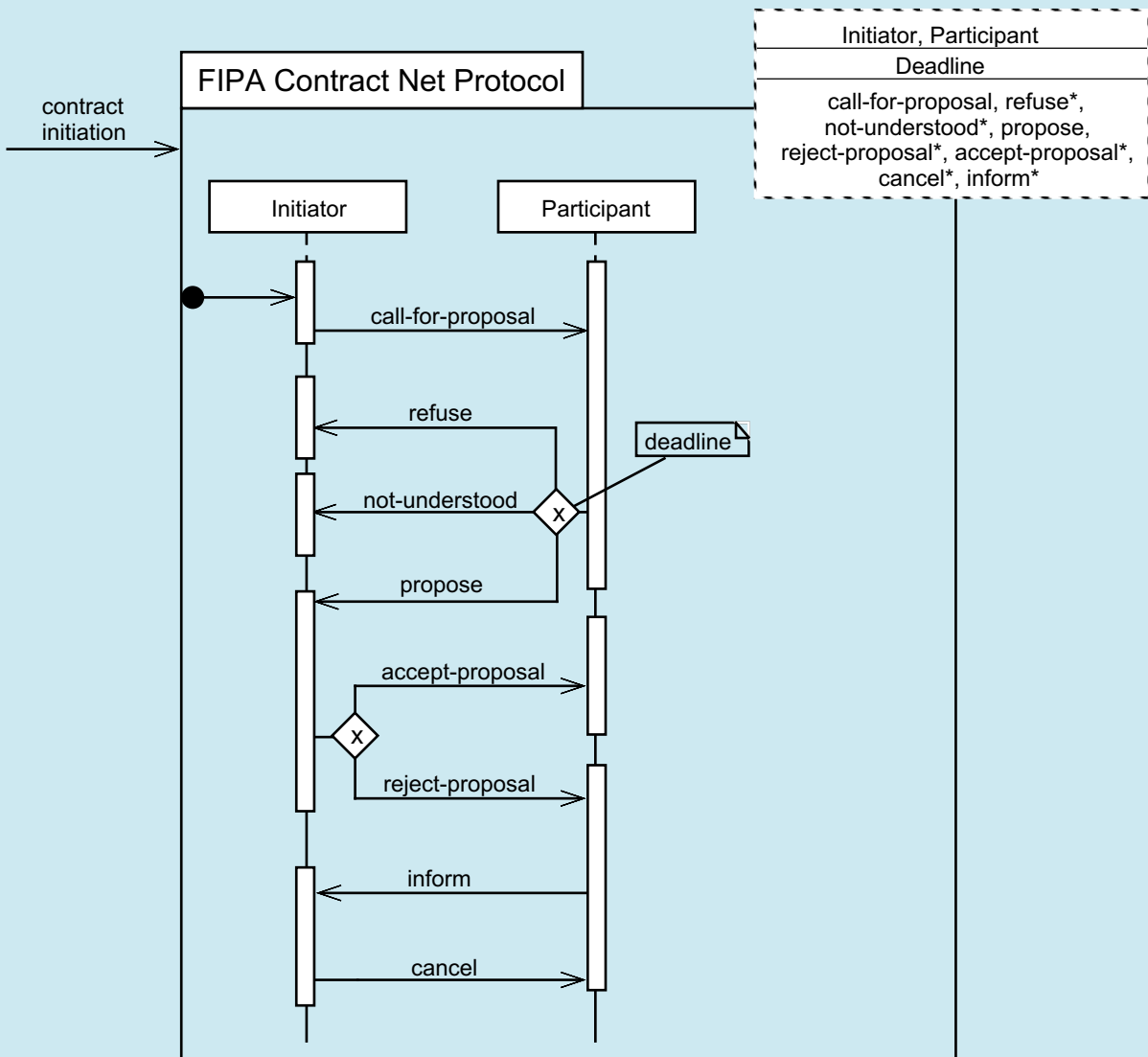
Static Diagrams

- Class diagrams
- Packages
- Component diagrams

***So, which will be useful for representing
agent interaction protocols?***

LEVEL 1

Generic AIP expressed as a template package



BINDING THE PARAMENTERS OF THE FIPA CONTRACT NET PROTOCOL PACKAGE TEMPLATE

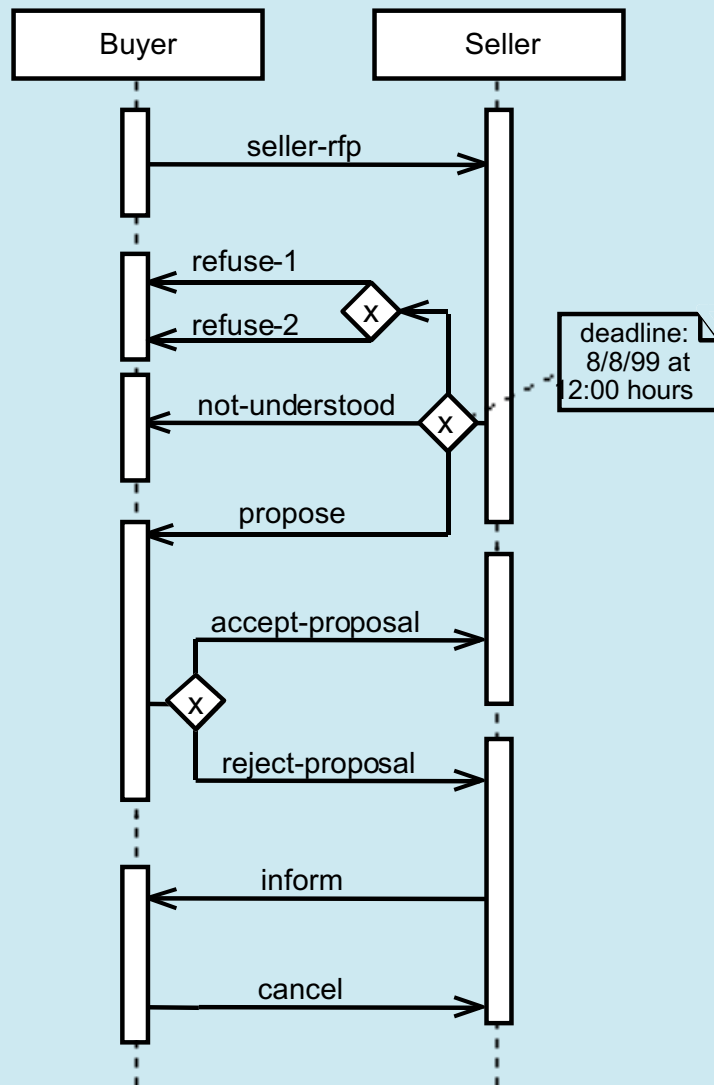
FIPA Contract Net Protocol

Buyer, Seller

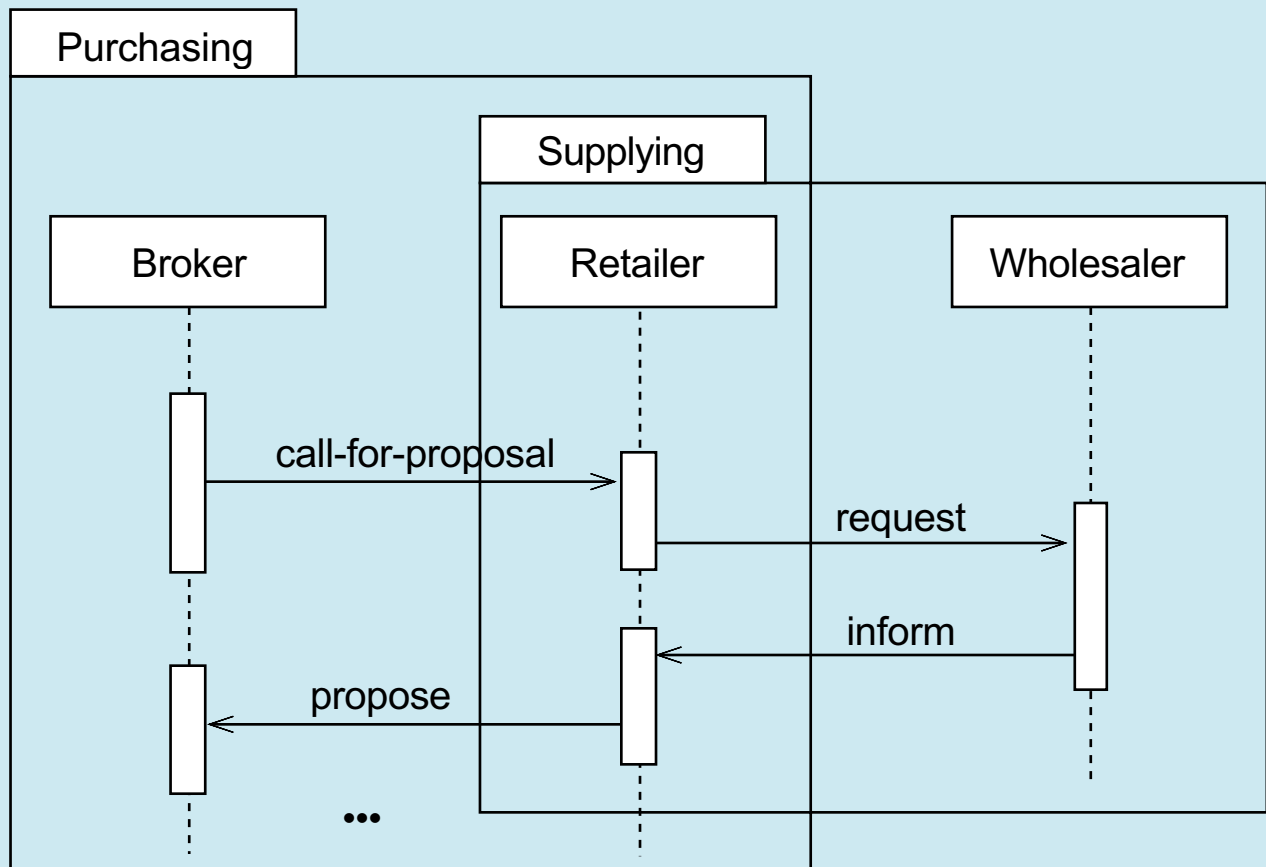
8/8/99 at 12:00

seller-rfp, refuse-1, refuse-2, not-understood, propose,
reject-proposal, accept-proposal, cancel, inform

APPLYING A TEMPLATE TO A PARTICULAR SCENARIO

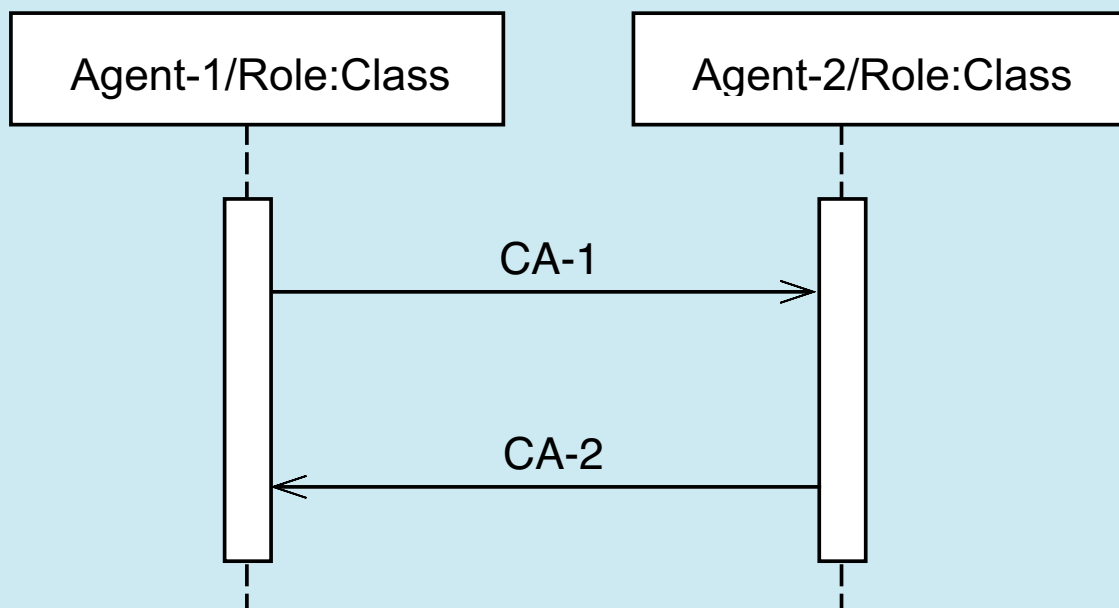


USING PACKAGES TO EXPRESS “NESTED” PROTOCOL



LEVEL 2:

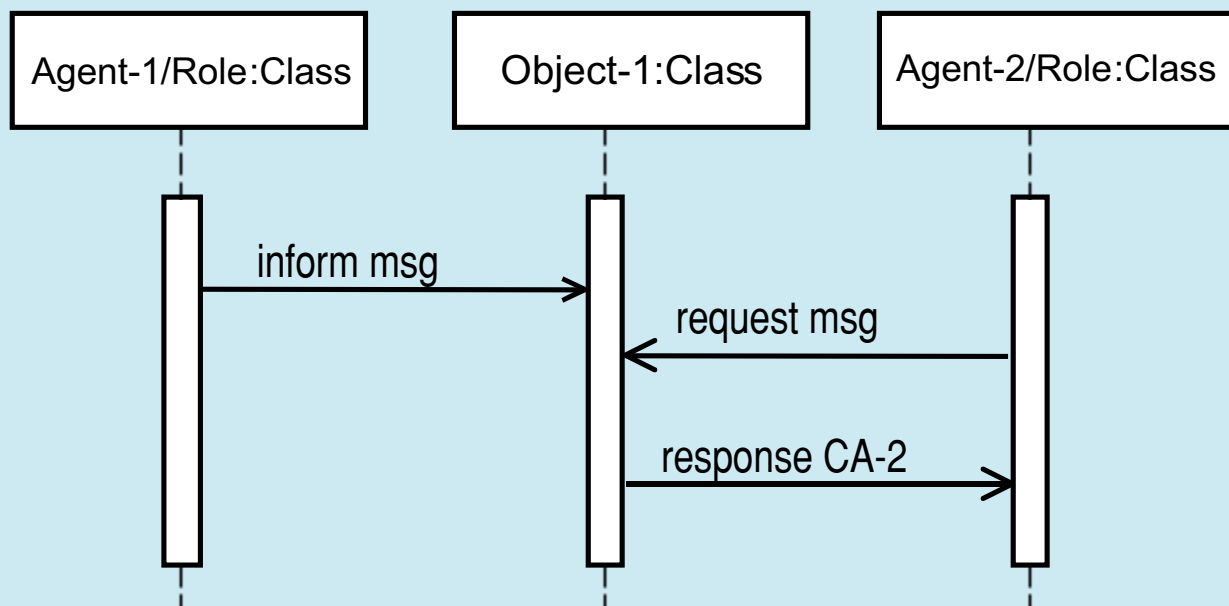
Basic format of Sequence Diagrams for agent communication



And, what is the difference between a role and a class?

LEVEL 2:

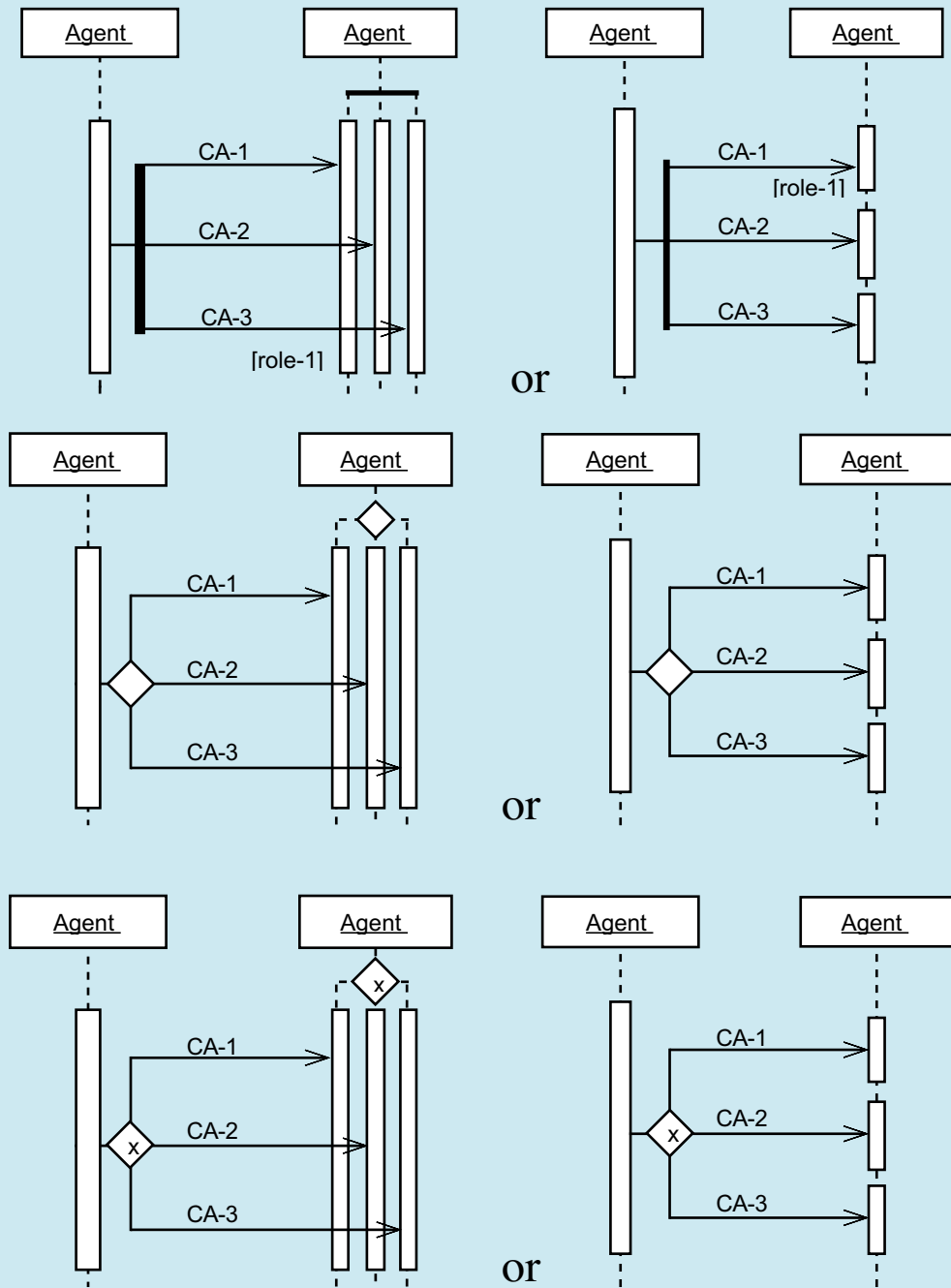
And don't forget that objects may play a part in agent communication



Definition—reconsidered?

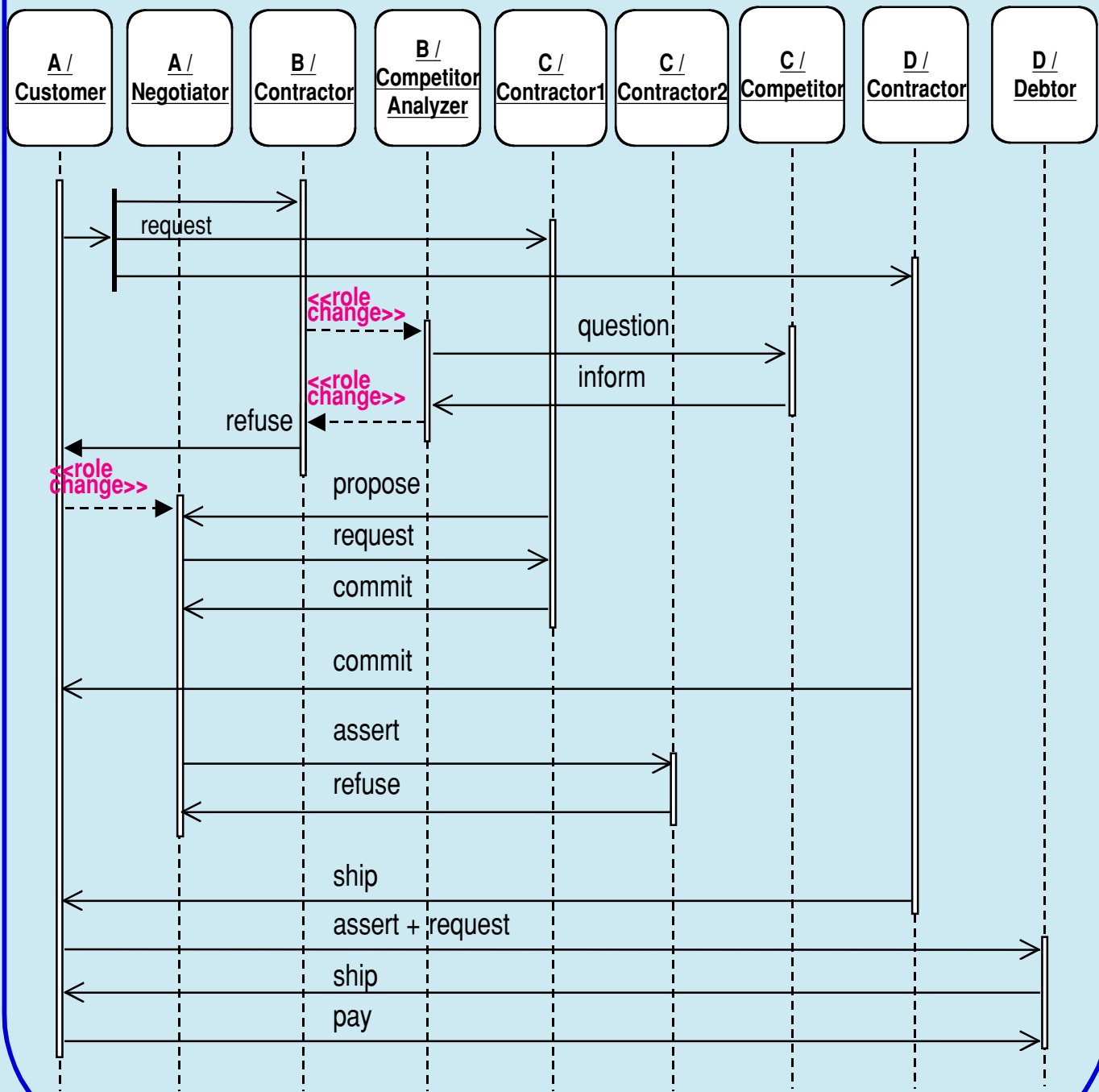
An agent interaction protocol (AIP) describes a communication pattern as a permitted sequence of messages among agents? and the constraints on the content of those messages.

CONCURRENT COMMUNICATION



SEQUENCE DIAGRAM

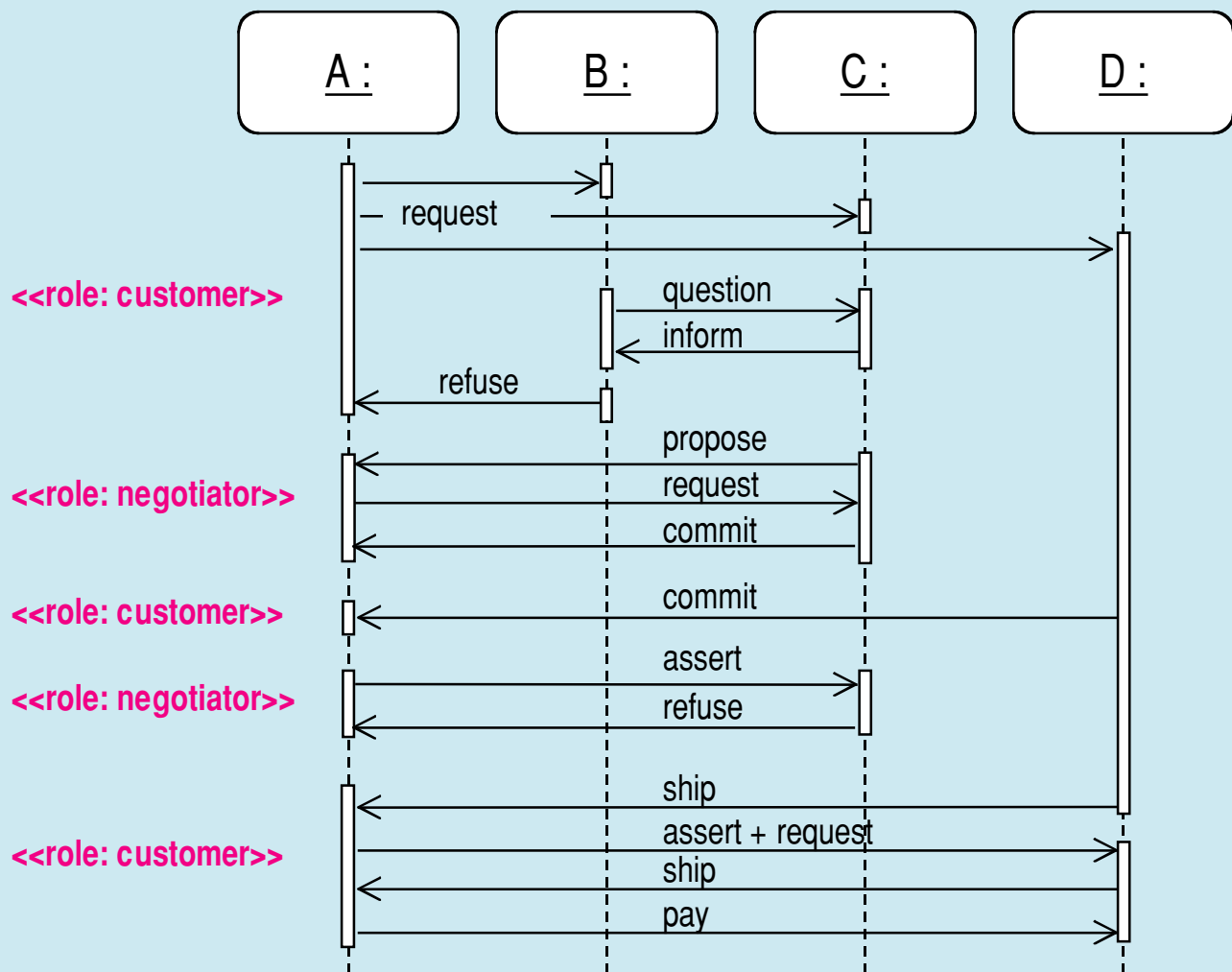
Example with agent instances



SEQUENCE DIAGRAM

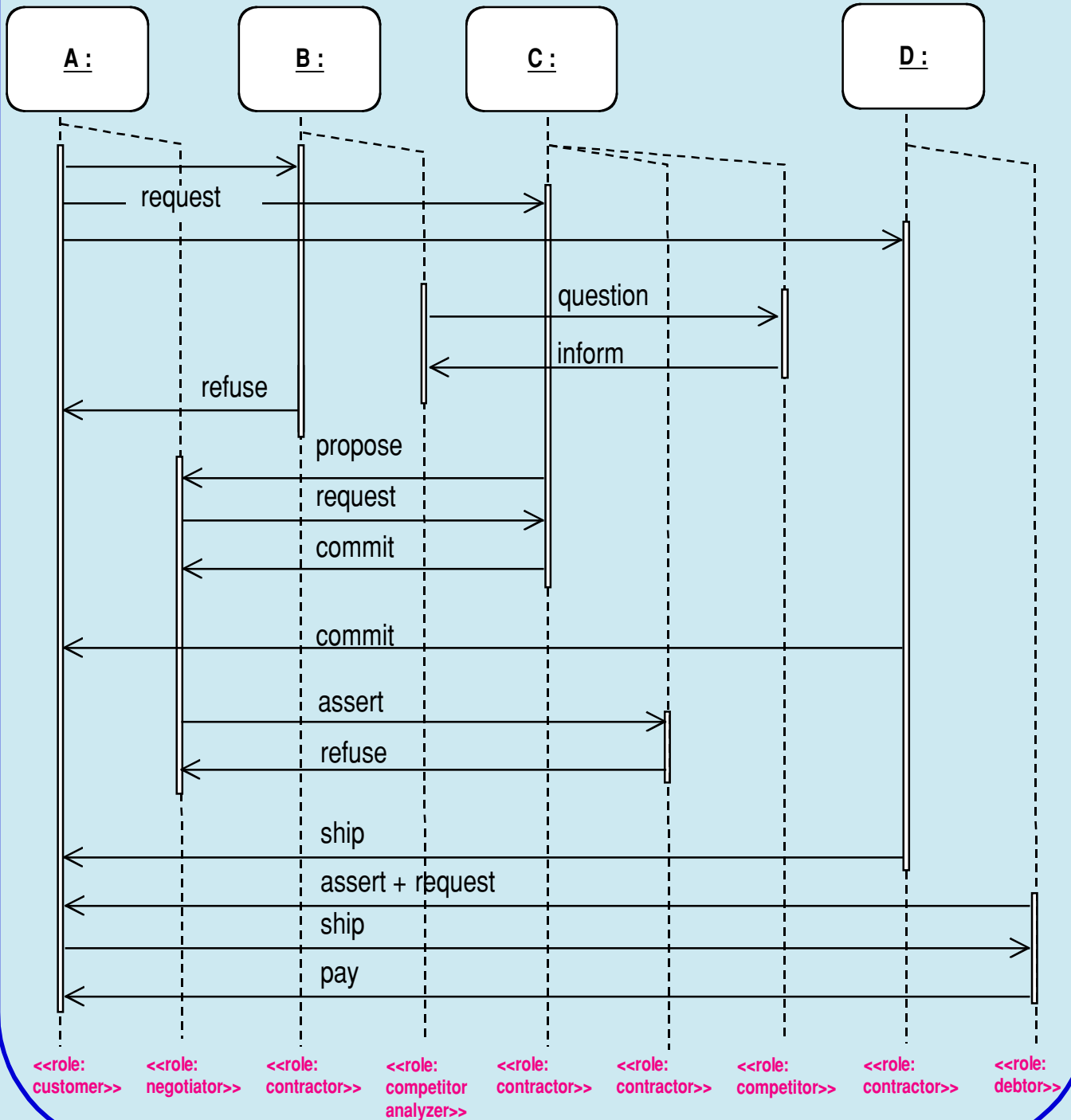
Alternative with roles as time intervals

(only A's roles labeled)



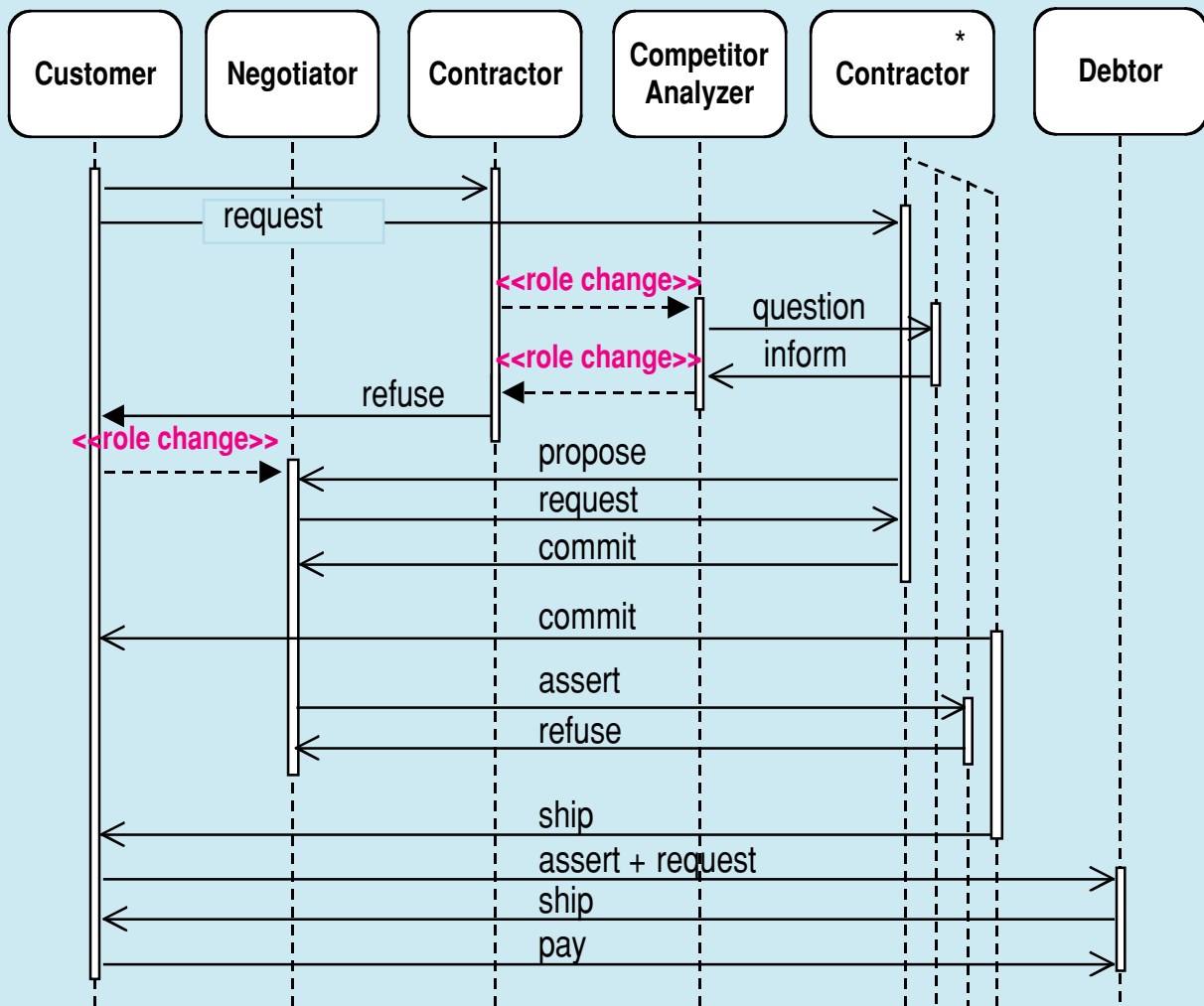
SEQUENCE DIAGRAM

Alternative with roles as parallel life-line branches



ROLES AS TYPES

Without individual agents



AND, CAN FIPA ACL HANDLE

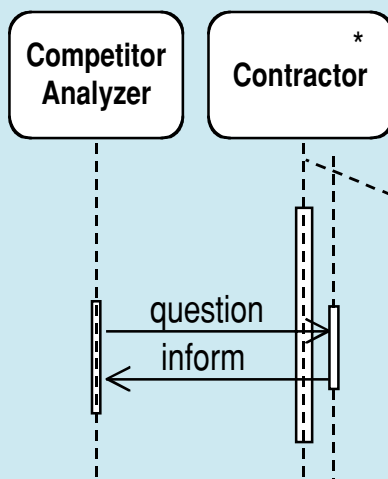
1:M and M:M COMMUNICATIONS?

In FIPA ACL, the sender is often required to believe something about the receivers:

e.g., “If an agent performs an inform act with ... three agents as receiver, it denotes that the sender intends each of these agent to come to believe the content of the message.”

Also, “the sending agent intends that the receiving agent also comes to believe that the proposition is true” and “does not already believe that the receiver has any knowledge of the truth of the proposition”

However, in a broadcast, you cannot know who the hearer is:



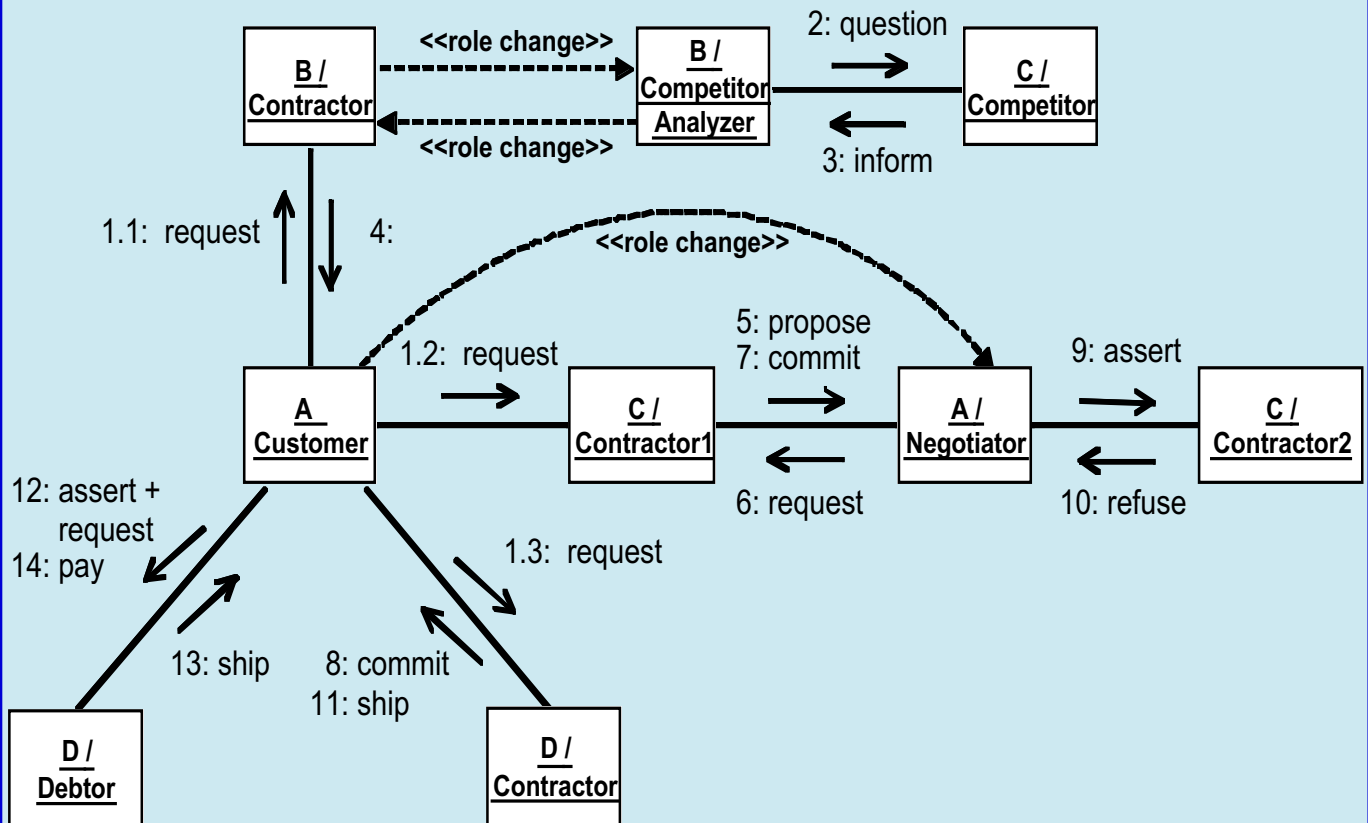
- “Beware of dog.”
- “Bob, take attendance.”
- “One of you, get a slice of pie.”
- “John & Betty request the pleasure of your company.”

We need more precise group semantics.

(Phil Cohen, Oregon Graduate Institute)

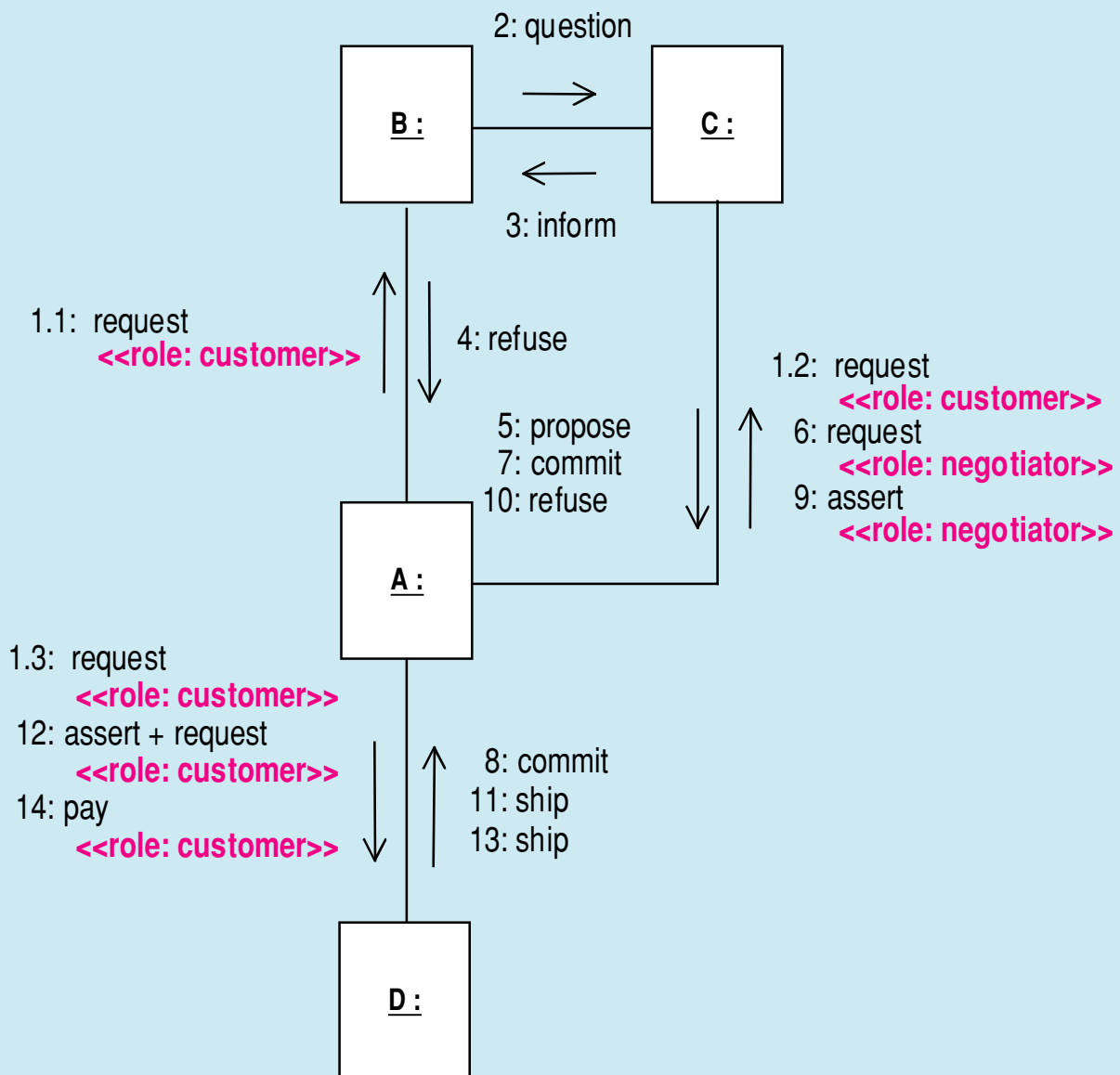
COLLABORATION DIAGRAM

An alternative representation



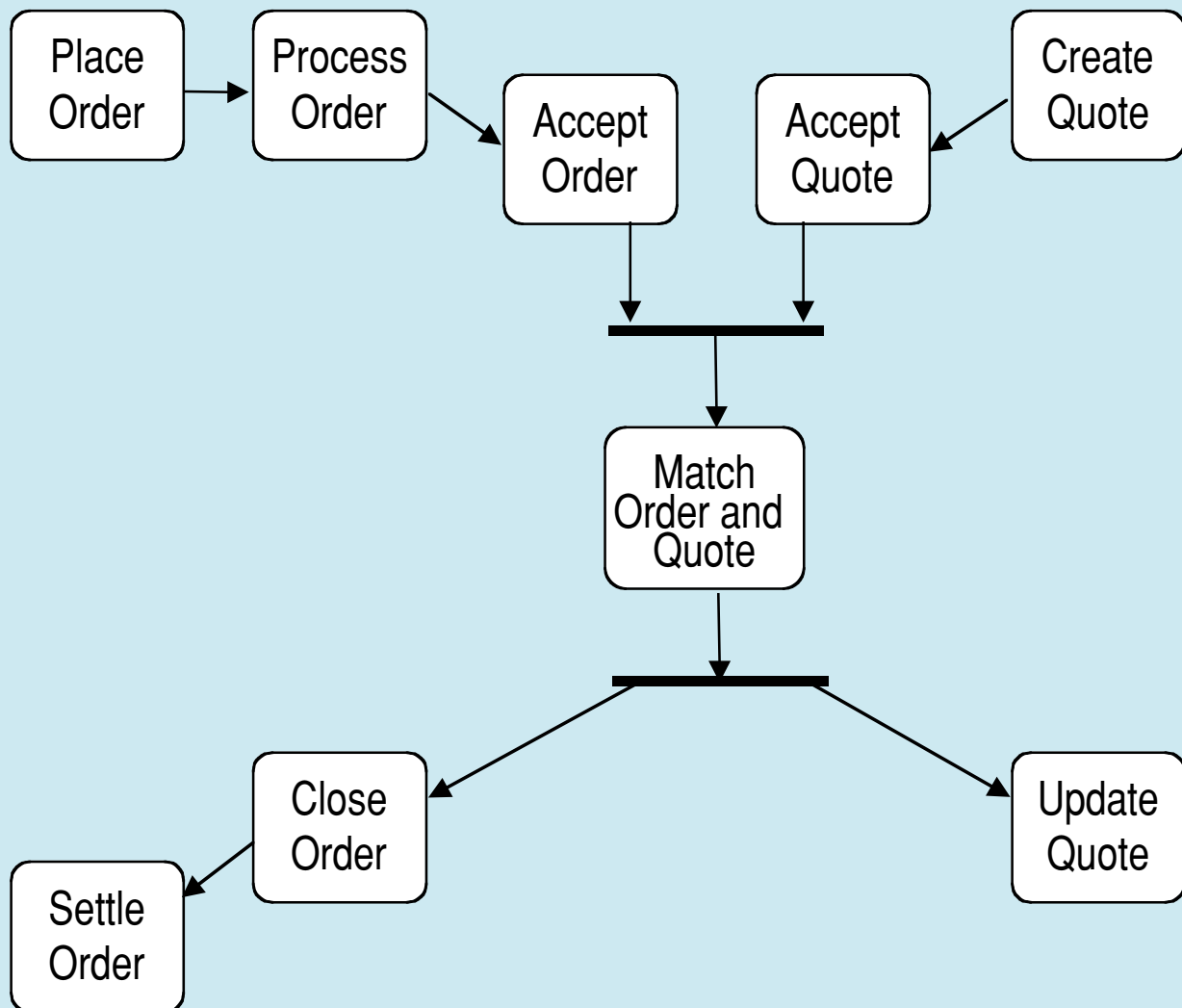
ROLES ON COMMUNICATION ACTS IN A COLLABORATION DIAGRAM

(only roles for A shown)



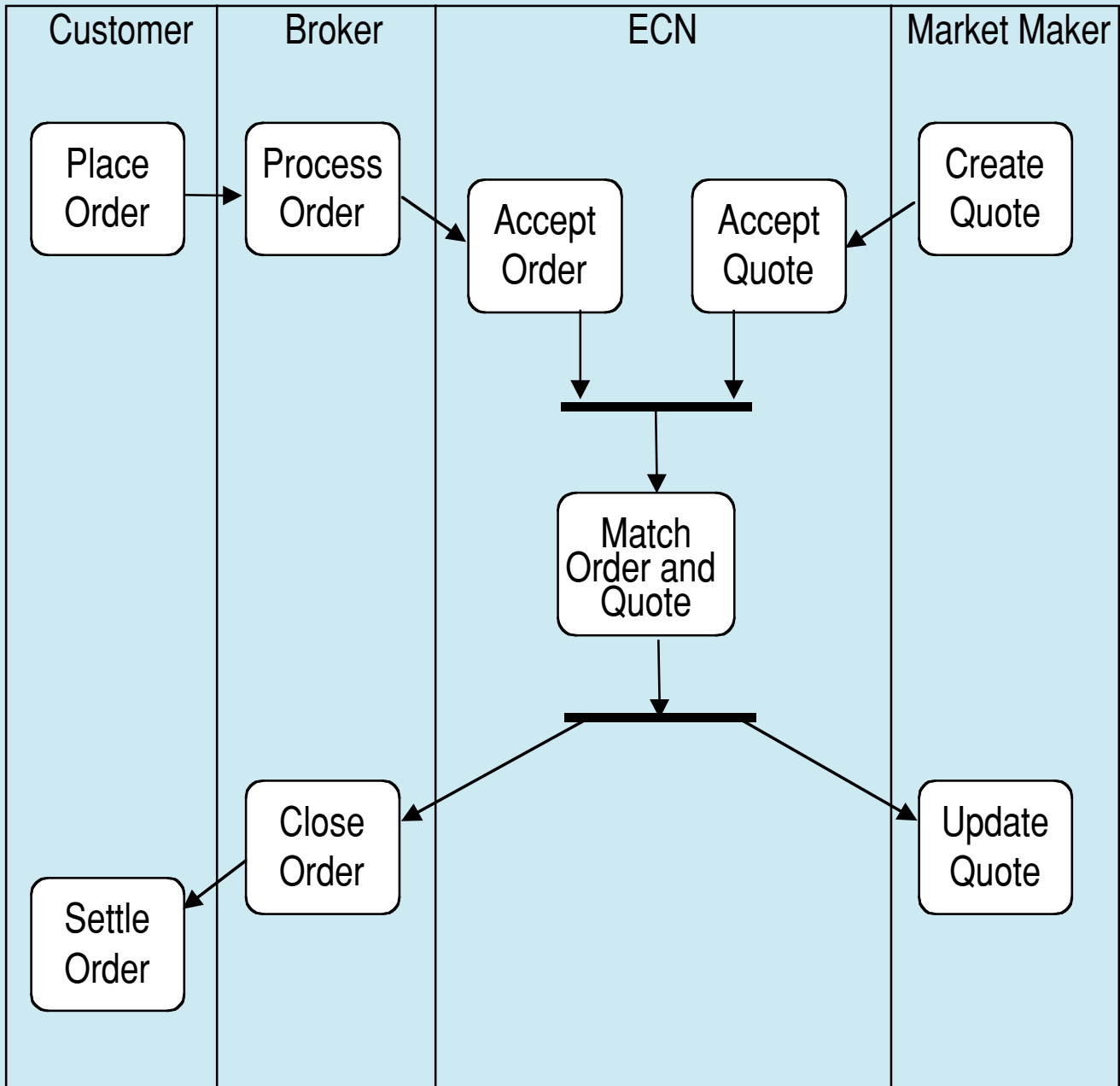
ACTIVITY DIAGRAMS

Another alternative representation



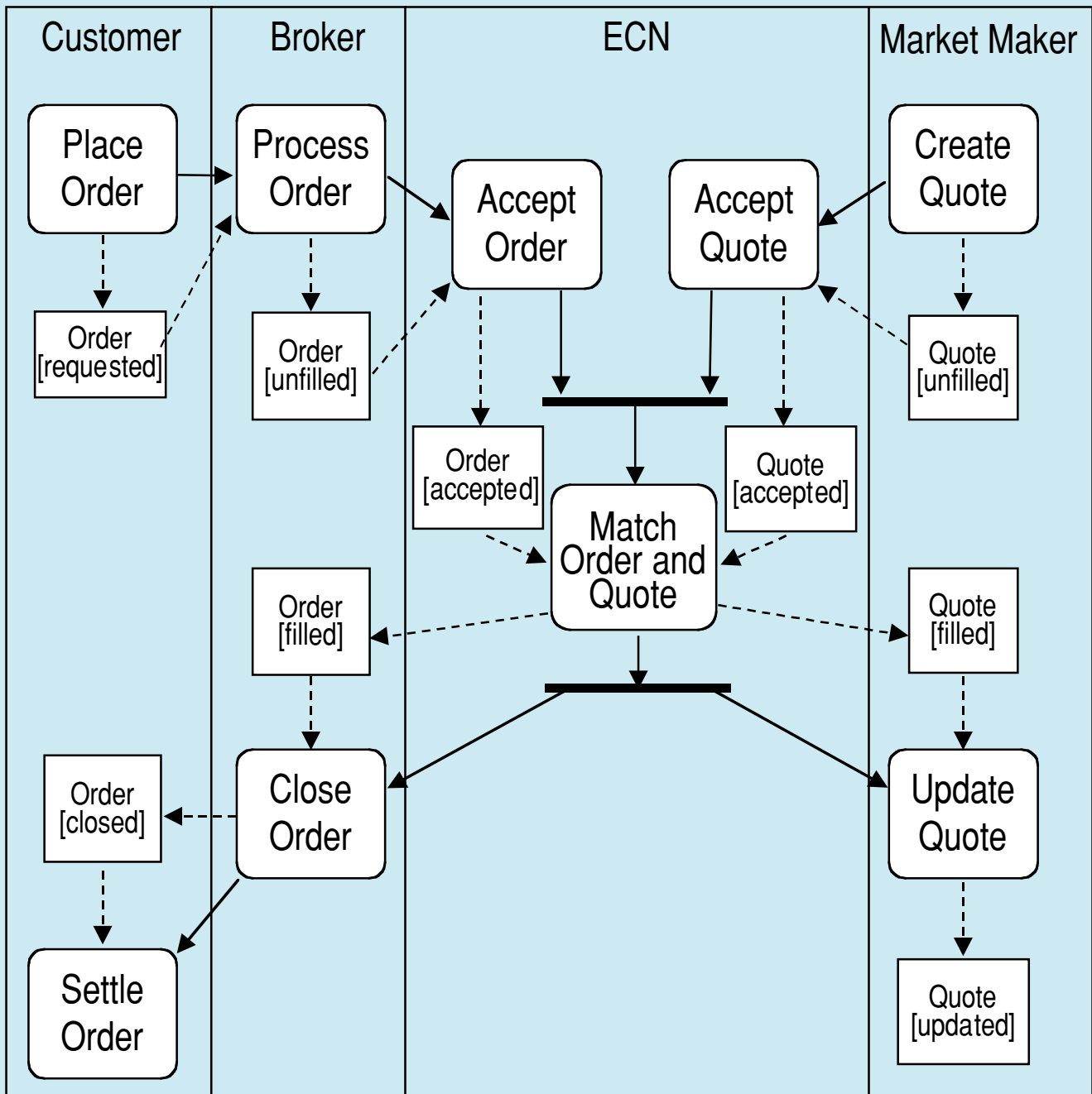
ORDER PROCESSING:

Activity diagrams with swimlanes



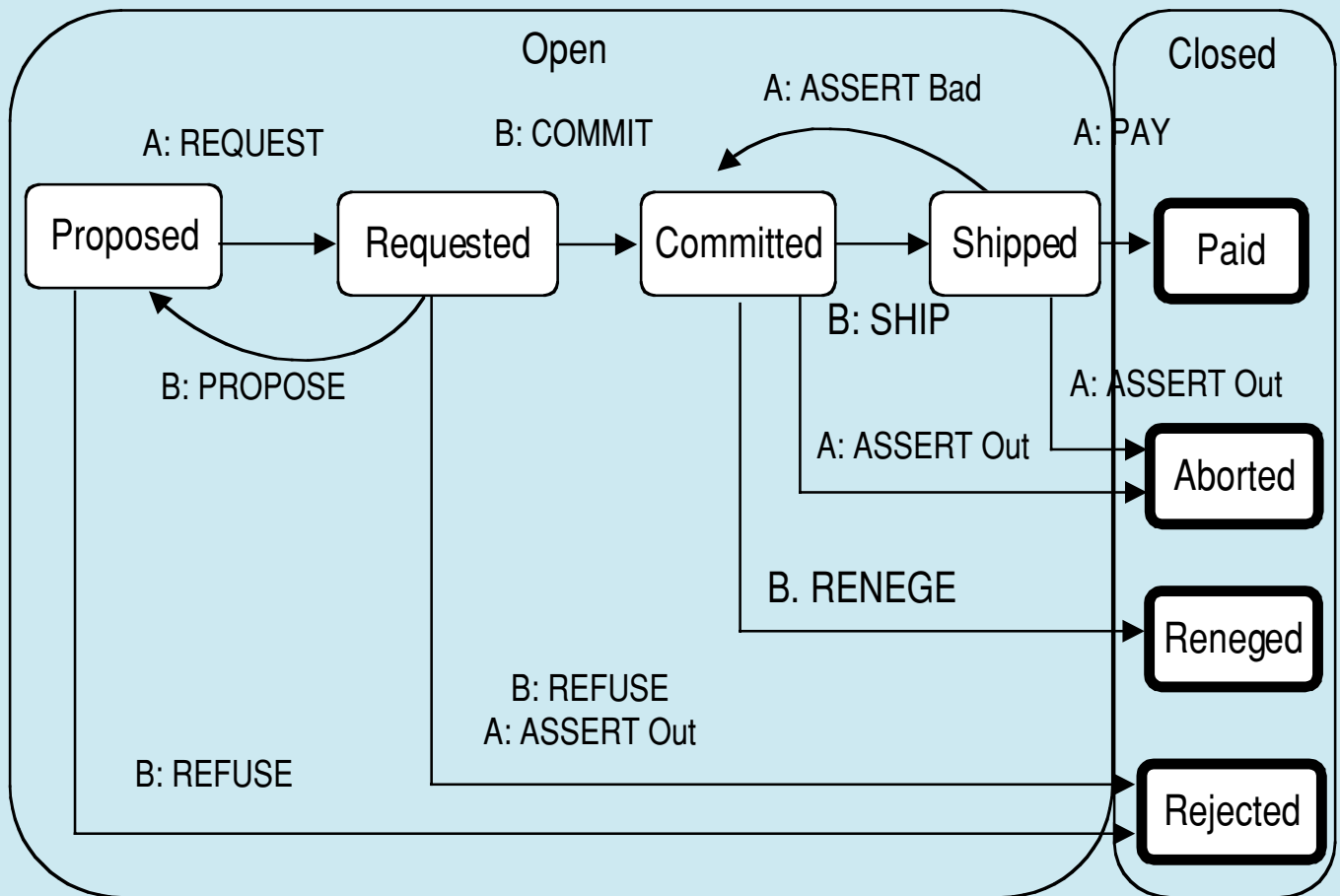
ORDER PROCESSING:

Activity diagrams with swimlanes and object flow



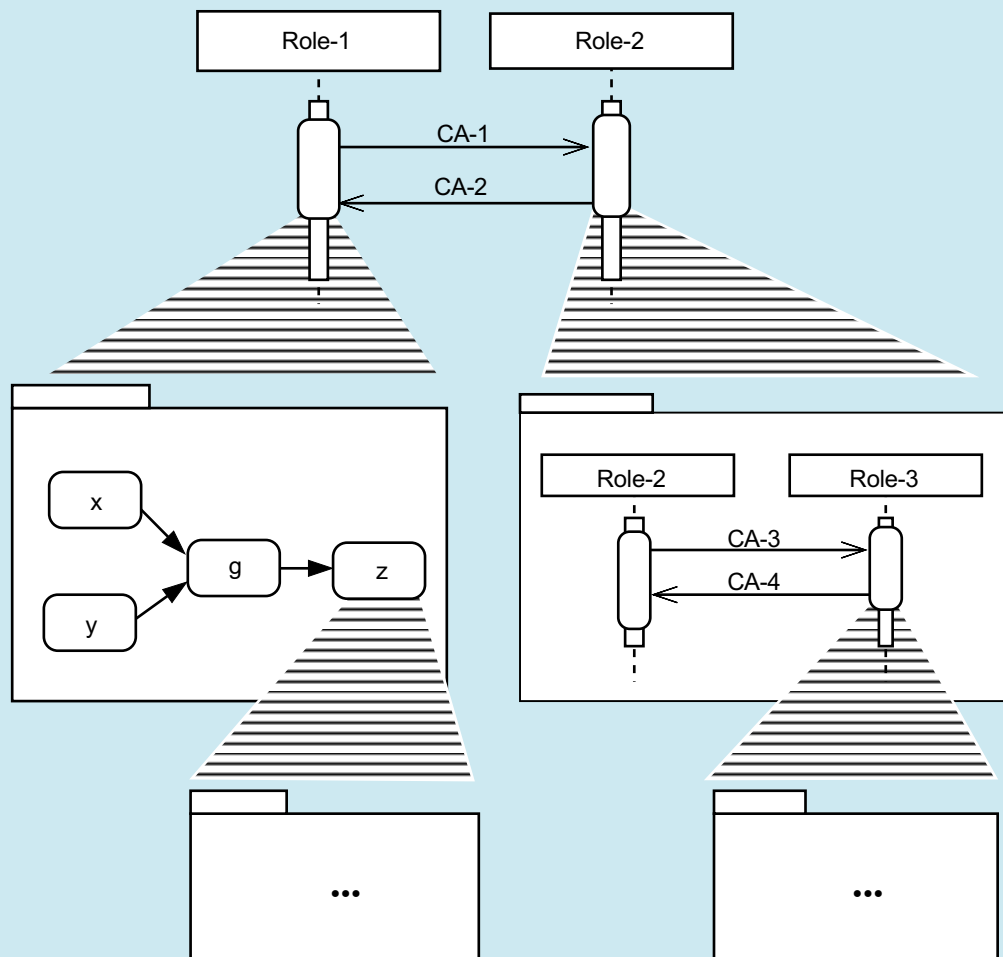
STATECHART NOTATION

Yet another alternative



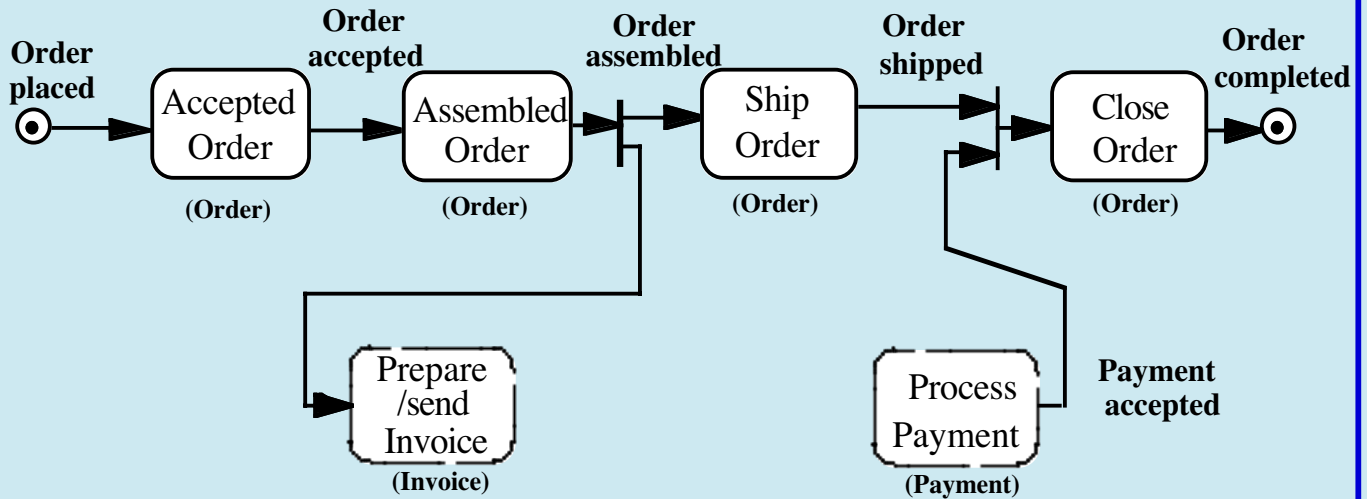
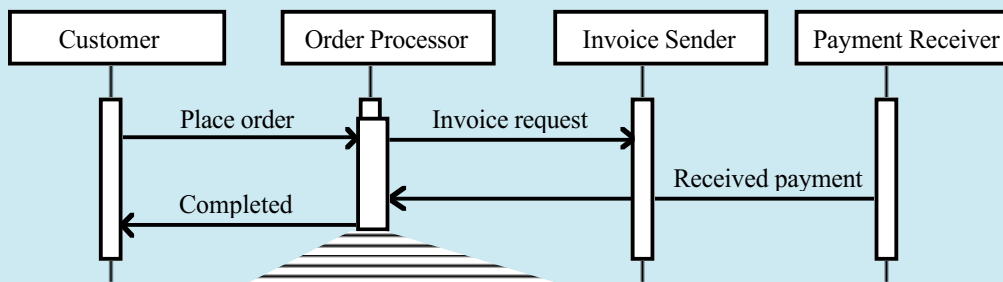
*A state-based speech-act version
of the Winograd-Flores protocol
in UML statechart notation*

INTERACTION PROTOCOLS CAN BE SPECIFIED IN MORE DETAIL



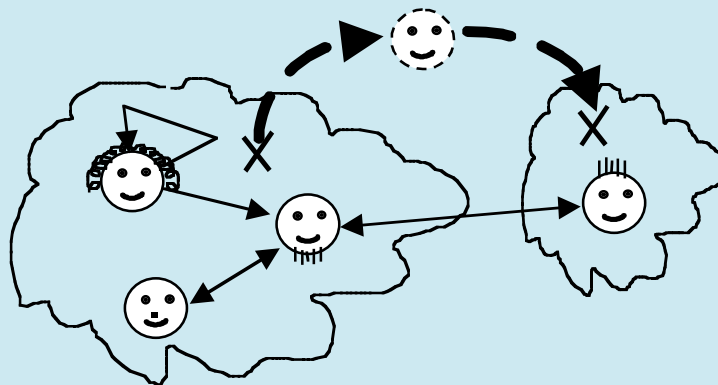
LEVEL 3

Generic AIP expressed as a template package



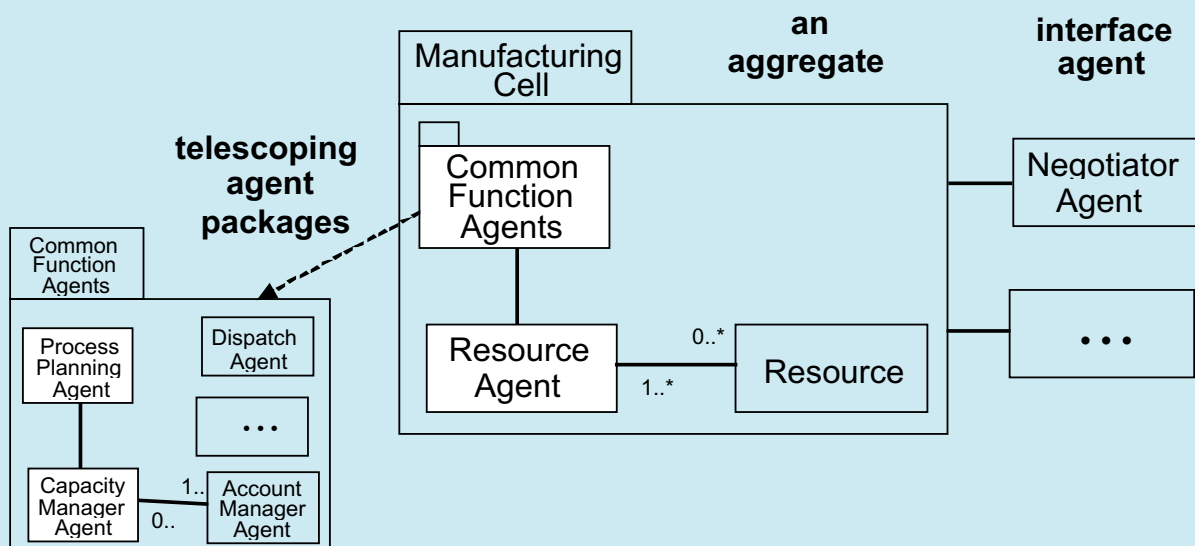
REPRESENTING AGENT INTERACTION PROTOCOLS IN UML

- ❑ Level 1: Representing the overall protocol
- ❑ Level 2: Representing interaction among agents
- ❑ Level 3: Representing internal agent processing



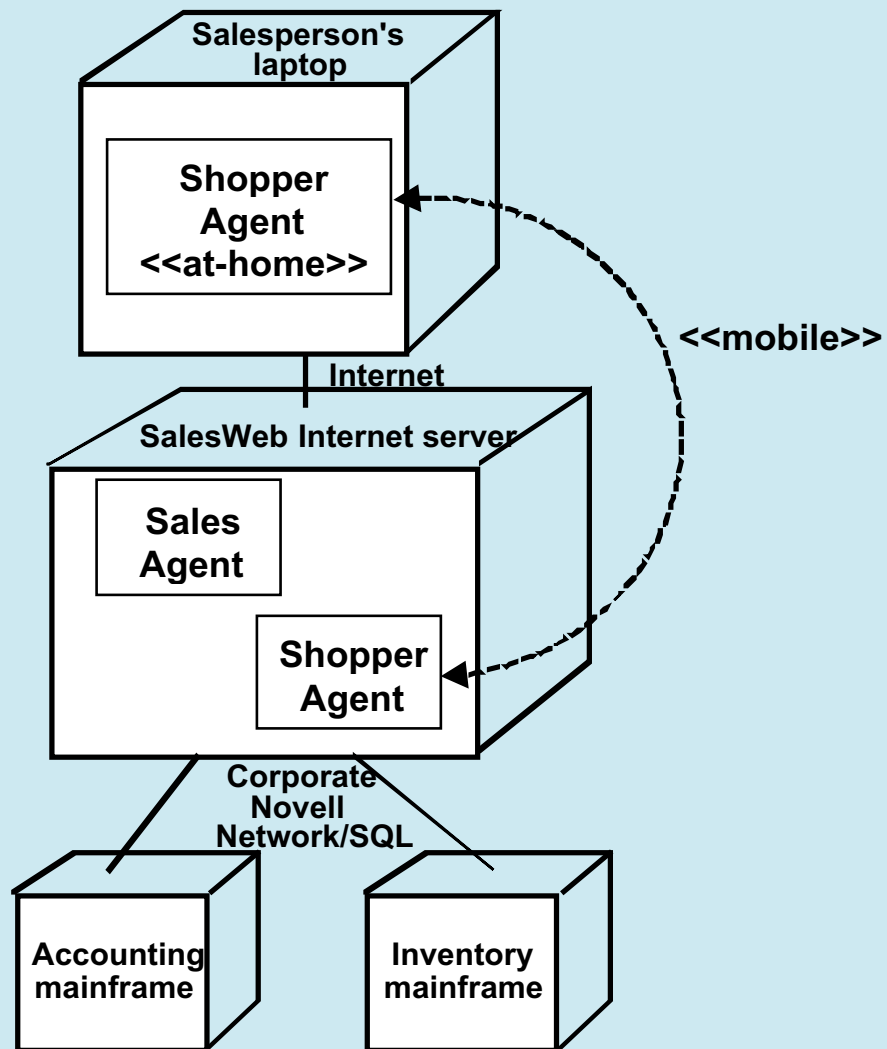
OTHER UML EXTENSION

Package specifying agents
instead of operations as interface points.



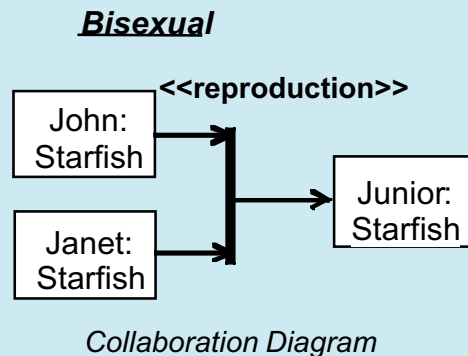
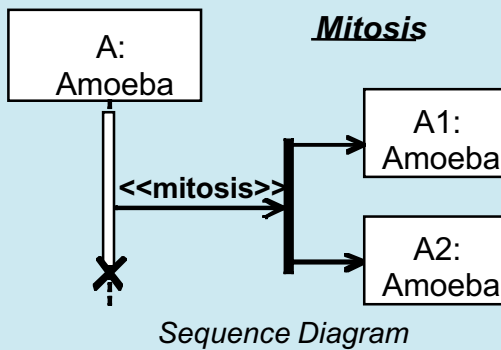
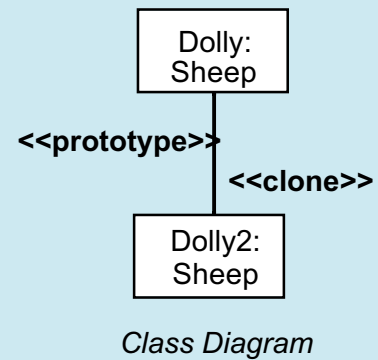
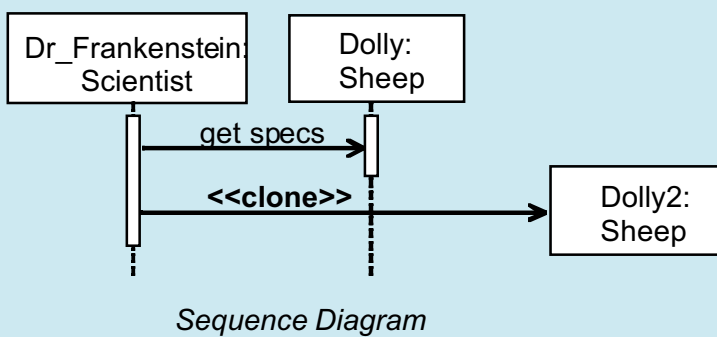
OTHER UML EXTENSION

Adding mobility to deployment diagrams.



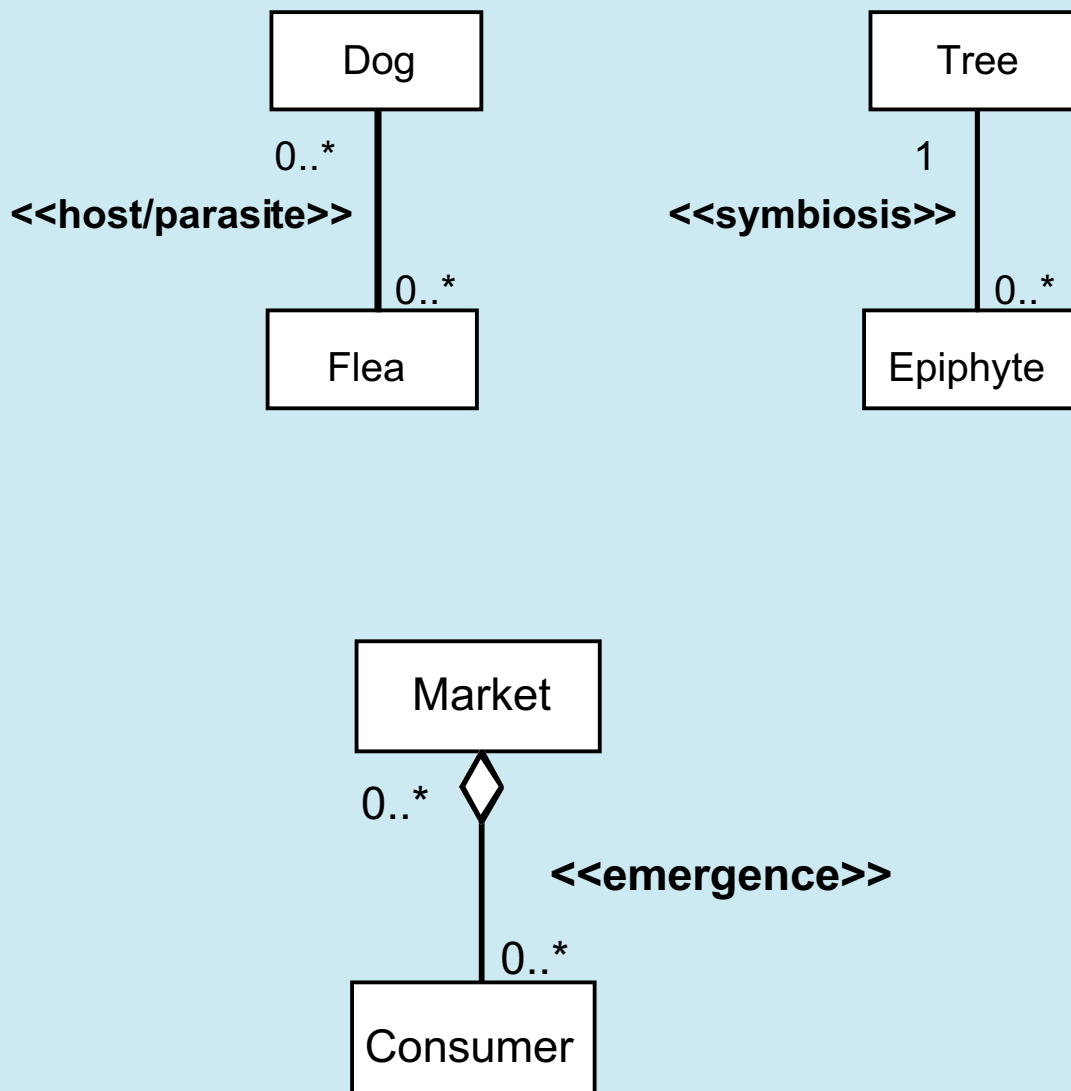
OTHER UML EXTENSION

Representing cloning, mitosis, and reproduction using sequence and activity diagrams



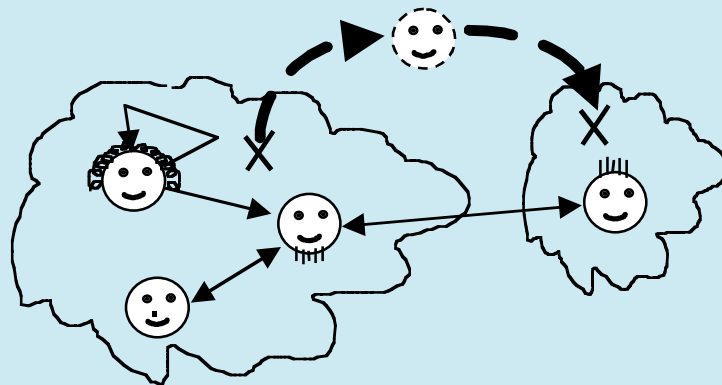
OTHER UML EXTENSION

Representing parasitic, symbiotic, and emergence relationship using class diagrams



Specifying agent interactions using UML:

What does this mean for current and future FIPA standards?



James J. Odell

www.jamesodell.com