Law Governed Peer-to-Peer Auctions

Marcus Fontoura
IBM Almaden Research Center
fontoura@almaden.ibm.com
Mihail Ionescu
Naftaly Minsky
Rutgers University

Agenda

- Online auctions
- Limitations of centralized auction services
- Law governed interaction
- Law governed interaction and auctions
- Sample auction law
- Related work
- Conclusions and future work

Online auctions

- Buyers and sellers scattered across the globe interact to close deals
- Faster and less expensive transactions with no geographical barrier
- Forecast Research expects that in 2003 there will be a market of 14 million consumers and $19 billion in sales

Limitations of centralized auction services

- The auction algorithm
  - Several types of such algorithms can be used (like open-cry, sealed, variations, etc.)
- Certification
  - How to compute reputation and trust information about the auction participants
- Auditing
  - What needs to be audited, and by whom
- The treatment of complaints
  - How to handle inappropriate behavior of auction participants

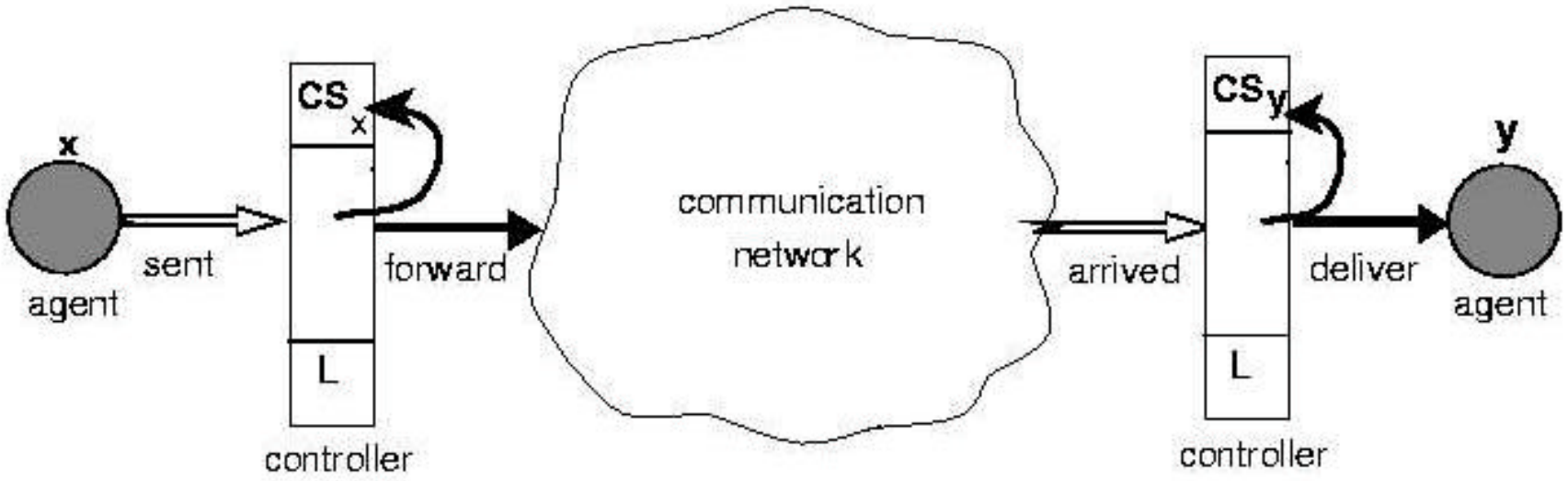
Law governed interaction (1/4)

- LGI is a message-exchange mechanism that allows an **open group** of distributed agents to engage in a mode of interaction **governed** by an explicitly specified policy, called the **law** of the group
- The group of agents interacting via **L**-messages is called a *community* **C**
- For each agent *x* in a given community has a *control-state* **CS(x)**
- **Agents** are black box components

Law governed interaction (2/4)

- Although the law **L** of a community **C** is *global* it is enforceable *locally* at each member of **C**
  - **L** only regulates local events at individual agents
  - The ruling of **L** for an event *e* at agent *x* depends only on *e* and the local control-state **CS(x)** of *x*
  - The ruling of **L** at *x* can mandate only local operations to be carried out at *x*, such as an update of **CS(x)**

Law governed interaction (3/4)



Legend:

a regulated event---------–---------- ⇒

a primitive operation ------ -------- →

Law governed interaction (4/4)

- Some LGI primitives
  - t@CS returns true if term t is present in the control state, and fails otherwise
  - +t adds term t to the control state;
  - -t removes term t from the control state;
  - forward(x,m,y) sends message m from x to y; triggers at y an arrived (x,m,y) event
- A *law* is represented as “Prolog” in Moses

Law governed interaction and auctions (1/4)

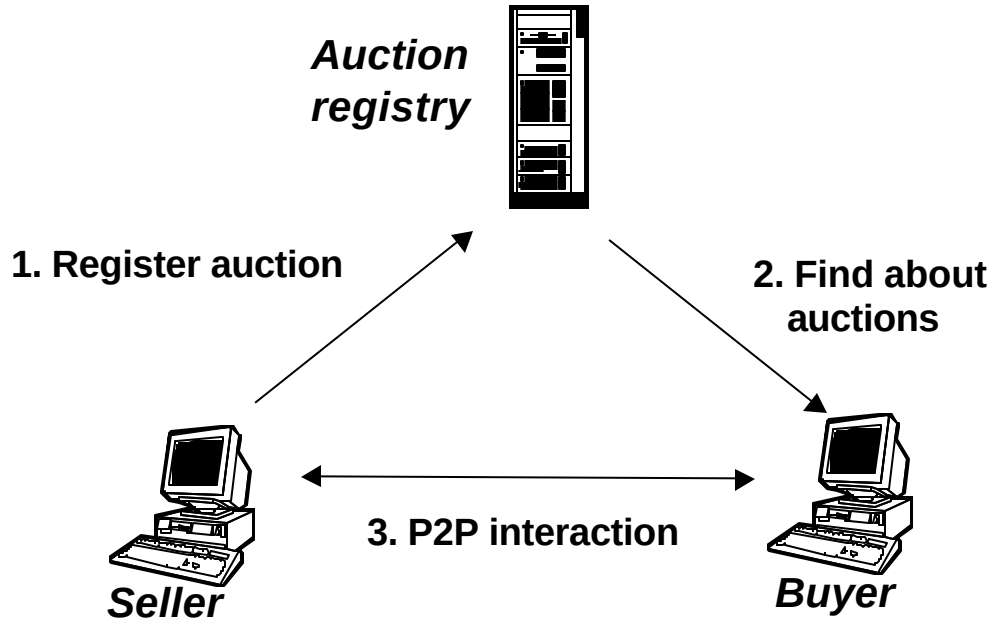
- **Auction registry**
  - The auction registry is a separate agent that holds the selling offers as a tuple *{ProductName, Description, SellerAddress, AuctionLaw, Timeout}*
- **Sellers and Buyers**
  - All the interaction between sellers and buyers is governed by LGI according to the auction policies (laws) specified in the registry tuples
- The actual exchange of product and money between the buyer that wins the auction and the seller is handled offline

Law governed interaction and auctions (2/4)

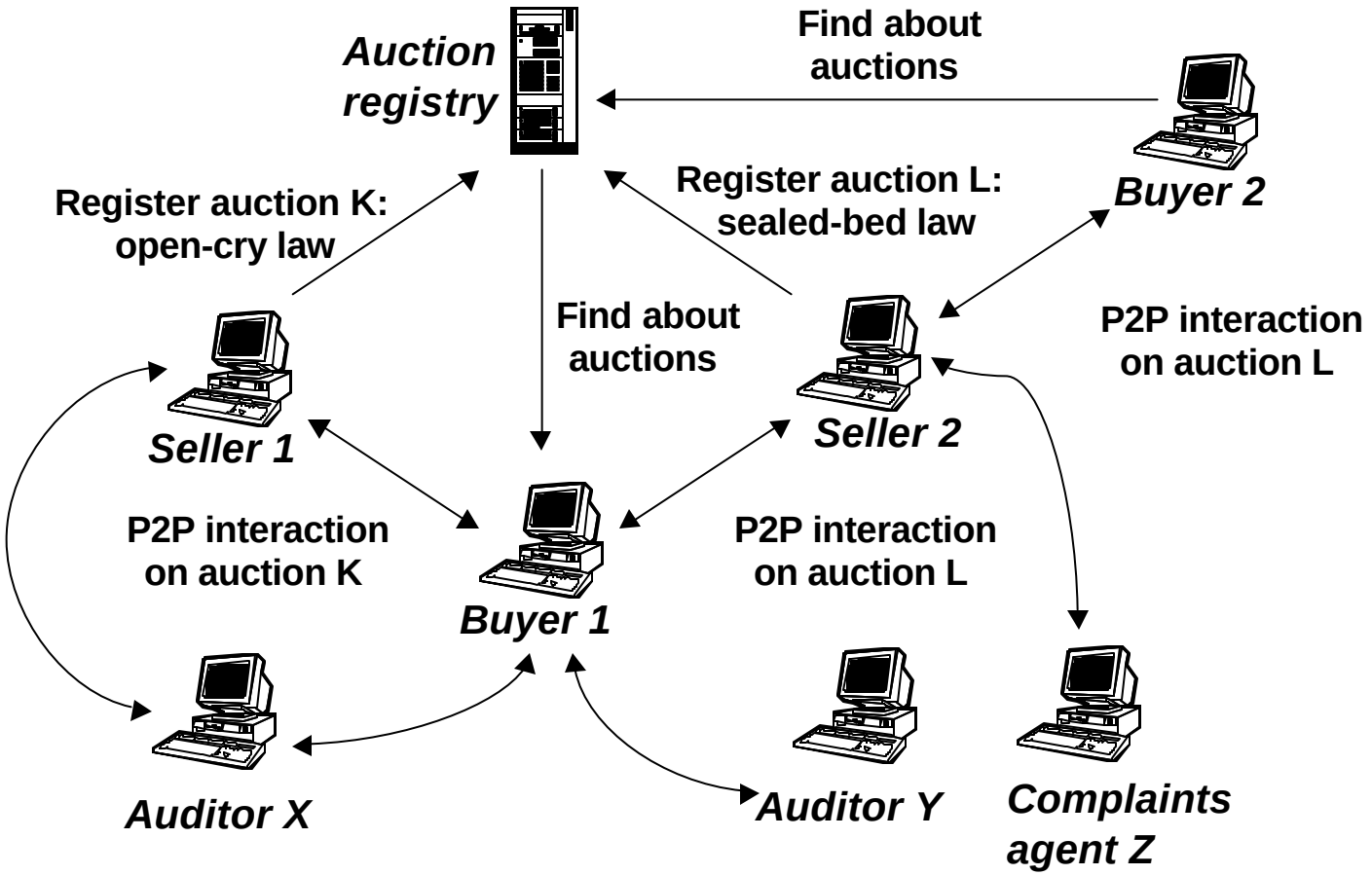
- Sellers send messages to the auction registry to insert or delete auction tuples
- Buyers make requests for offers that meet some conditions
- When a buyer discovers about an interesting auction, it can join the community that is conducting the auction
- Buyers and sellers exchange messages according to the law specified in the auction tuple
- They interact directly, in a peer-to-peer communication model

Law governed interaction and auctions (3/4)

- Interaction among sellers, buyers, and the auction registry



Law governed interaction and auctions (4/4)



Sample auction law (1/5)

Initializations

R1. Directory(auditor, auditor@enterprise.com)

R2. Authority(ca,URL(http://aramis.cs.rutgers.edu:9020))

R3. InitialCS([])

Certification

R4. certified(X,certificate(issuer(ca),subject(Y),attributes([seller(N)]))) :-
do(deliver(X,certificate(issuer(ca),subject(Y),attributes([seller(N)])),X)),
do(+certified),do(+role(seller)),repealObligation(endCertified(X)),
imposeObligation(endCertified(X),100),
do(deliver(X,attributes([seller(N)],auditor)

Sample auction law (2/5)

Seller starts the auction

R5. sent(X,start(P,T),X) :-

certified@CS, role(seller)@CS, do(+P), do(+max(P,0)),
do(+winner(P,X)), do(imposeObligation(timeout(P),T)),
do(deliver(X,start(P,T),auditor)

Sample auction law (3/5)

The "open cry" auction

R6. sent(X,offer(P,M),Y) :-

certified@CS, role(buyer)@CS, do(forward(X,offer(P,M),Y)), do(deliver(X,offer(P,M,Y),auditor)

R7. arrived(X,offer(P,M),Y) :-

role(seller)@CS, max(P,Q)@CS,winner(P,Z)@CS, M>Q, not role(buyer)@CS, do(-max(P,Q)), do(+max(P,M)), do(-winner(P,Z)), do(+winner(P,X)), do(forward(Y,accepted(P,M),X)),

do(deliver(Y, accepted(P,T,X),auditor), do(forward(Y,outbid(P,M),Z)), do(deliver(Y,outbid(P,T,Z),auditor)

Sample auction law (4/5)

- Auditing
  - Auditor is an agent that is not involved in the auction but that receives copies of the messages that were exchanged
  - Agents can request copies of the messages exchanged during the auction
  - An auction can have more than one auditor
  - An agent can choose not to participate in an auction if it does not trust its auditors
  - The law imposes no restrictions in the way auditors handle the messages they receive.

Sample auction law (5/5)

- Treatment of complaints
  - An agent can complain about another agent (A) if he or she thinks that A did not have a correct behavior.
    - Not sending the item once the auction is over
- Prevention of the artificial increase of the price by the seller
- The complaints agent can talk to the auditor to retrieve copies of all the exchanged messages and the real IDs (as are written in the certificates) of the agents

Related Work

- Centralized auction services
  - B2B
  - B2C
- AuctionBot
  - Configurable auction policy
- UDDI
  - Auction registry

Conclusions and Future Work (1/2)

- Sellers can set up their own auction policies and these policies are **explicitly stated**, readable by everybody, and strictly **enforced** by the LGI mechanism
- Auctions are conducted in a totally distributed manner, through a **peer-to-peer** communication protocol
- There is **no centralized authority** that can act as a trusted mediator.
- Third parties, such as **auditors and complaints agents**, can participate on the auctioning process under a given law
- This architecture is **not limited to auctions**, but it can be applied to any online trading model

Conclusions and Future Work (2/2)

- Definition of laws for other types of negotiation
  - Especially interested in studying the behavior of agents in the presence of several optional (and conflicting) laws
- Integration with Web services
  - UDDI and WSDL
- Web-based user interface for the system