CS 161 – Electronic Commerce

15 November 2006

Stages in E-commerce purchase

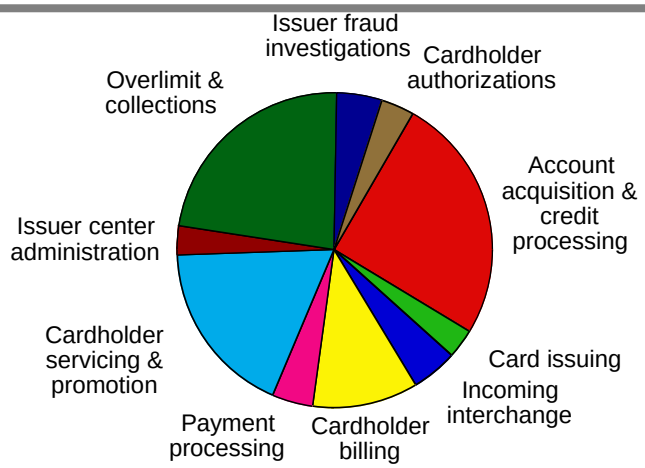
Stages in e-commerce purchase

- Advertising
- Solicitation
- Negotiation
- Purchase
- Payment
- Delivery
- Ordering/support

Credit cards as an enabler

- Standard purchase model reveals credit information
- Overhead costs can be high for microtransactions
- Acquiring Bank vs. Consumer Bank
- Payment processors

Why is a credit card transaction 50¢?



Information goods

- Consider the purchase of an information good or service:
  - Library information
  - Search services
  - Software
  - Video clips
- These transactions may be large value or microtransactions
- In either case, atomicity is crucial

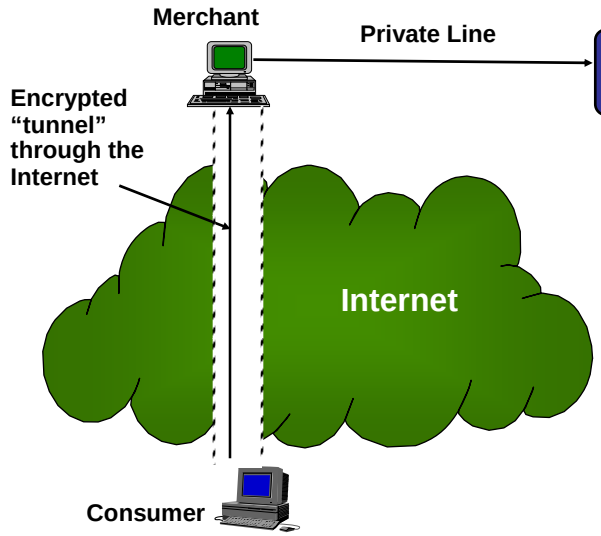
Payment methods: Atomicity

What is atomicity?

- I won't try to give a formal definition
- 3 types of atomicity:

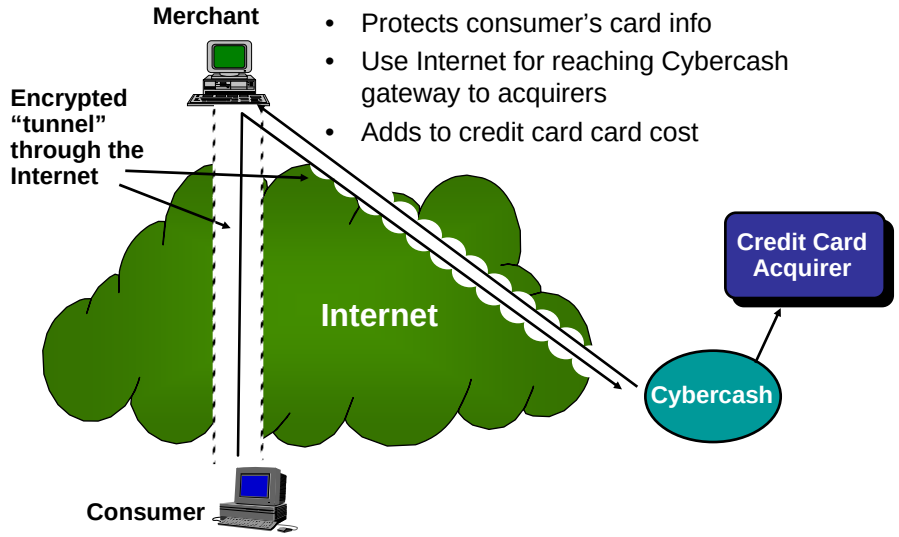
- Money atomicity
  - All money transfers complete with non-ambiguous results
  - Money is neither destroyed nor created
- Goods atomicity
  - One receives goods if and only if one pays
  - Example: Cash On Delivery parcels
- Certified delivery
  - Both buyer and seller can prove the delivered content
  - If you get bogus goods, you can prove it

SSL model



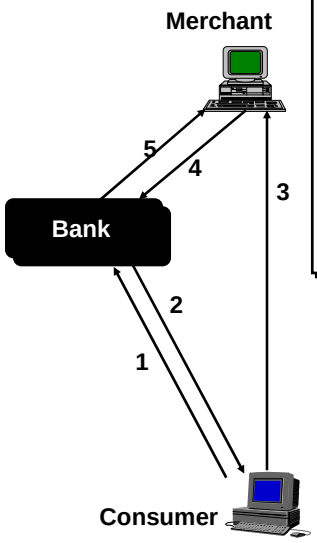
- Consumer sends card # direct to merchant
- Similar to today's phone order
- Must trust merchant with card info
- Weak atomicity
- High transaction costs

Third party intermediary (Verisign)



- Protects consumer's card info
- Use Internet for reaching Cybercash gateway to acquirers
- Adds to credit card card cost

Digicash



1 Consumer asks bank for anonymous digicash
2 Bank sends anonymous digicash bits to consumer
3 Consumer sends digicash to merchant in payment
4 Merchant checks that digicash has not been double spent
5 Bank verifies that digicash is valid

Problems

- **No atomicity**
- **Anonymity restricted in US**
- **Interrupt transaction: ambiguous state**
- **Detecting double spending is expensive**

NetBill goals

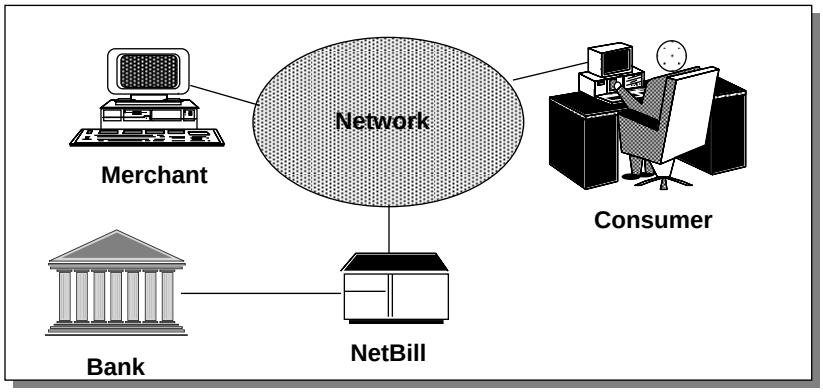
- Real service
- Highly atomic transactions
- Micro-transactions
- Full security and privacy

NetBill features

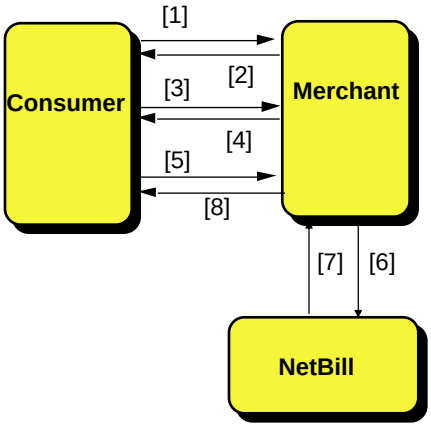
- Focus on info goods/services (journal articles)
- Microtransaction (10¢ purchase: 1¢ overhead)
- Variable pricing
- Fully integrated access control
- DES/RSA/DSA combo for best performance
- Electronic statements & account creation
- Certified delivery: proof of purchase/content

Netbill model

- An electronic credit card to enable network based commerce
- Provides billing services on behalf of network attached merchants.



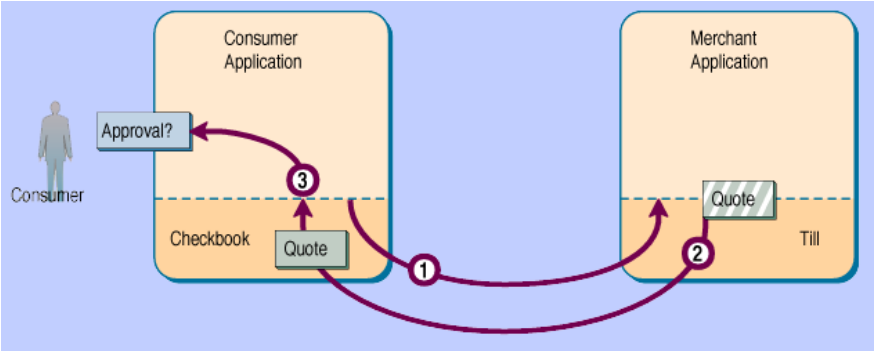
Netbill protoocol



(All messages are encrypted with shared key S)

1 Buyer requests price
2 Seller makes offer
3 Buyer accepts offer
4 Goods delivered encrypted with K
5 Buyer signs EPO (electronic purchase order) <price,crypto-checksum,timeout>
6 Seller countersigns EPO, and signs K
7 NetBill checks account, timeout;
stores K & crypto-checksum;
transfers price money;
sends signed receipt including K
8 K received; goods decrypted

Netbill protocol – low level



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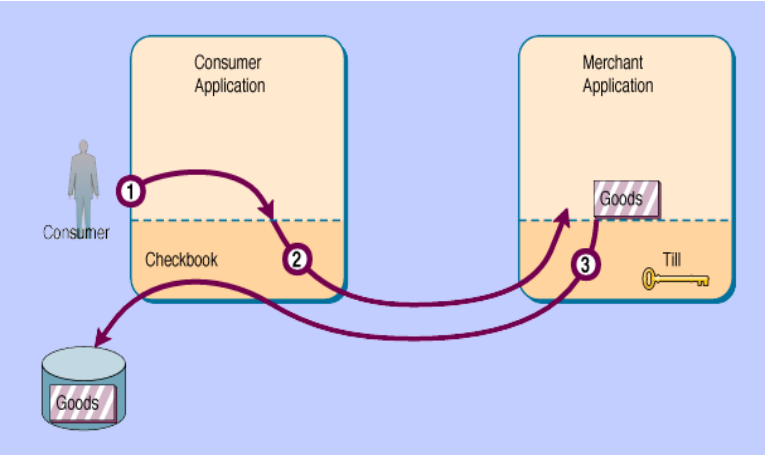
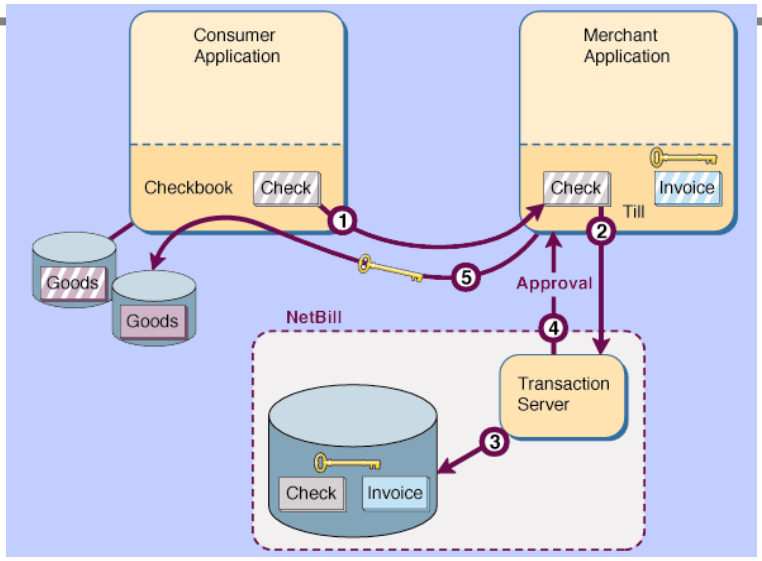


Netbill protocol – low level



Netbill protocol – low level

- Money atomicity
  - Accounts are held at a single server, and are modified with local atomic (ACID) transactions
- Goods atomicity
  - Customer receives decryption key for goods only if she pays
  - If customer pays, decryption key available from multiple sources (merchant and NetBill server)
  - Key can be delivered by alternative network (such as telephone) if necessary
- Certified delivery
  - If customer receives junk or bogus goods, can prove the contents to a judge
  - Crypto checksum of goods (signed by both customer and merchant) are stored at NetBill server
  - Signed copy of decryption key stored by all parties!

Role of Anonymity in EC

Why study anonymity?

- Privacy concerns
  - individual
  - corporate
  - national
- Technology for collecting private statistics
- Understand theoretical limits, countermeasures
- Understanding semi-anonymity
  - Allows government search in exceptional circumstances
- Insights
  - e-commerce
  - distributed protocols
  - cryptography
  - survivability

Anonymous computation

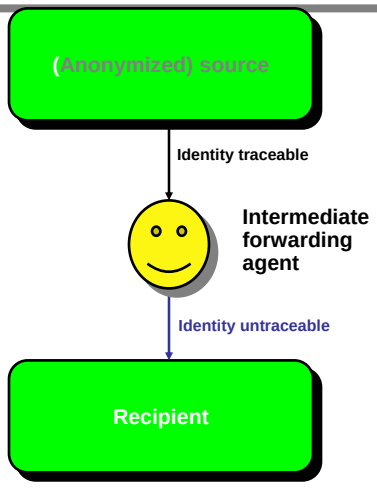
- There is extensive work on anonymous and secret communication (cryptography)
- But what if we want to compute a function of the secure values?
- In puzzle, we want to add “encrypted” values
- Examples:
  - Compute census statistics on usage or population
  - Make an anonymous purchase and then be able to prove that goods were delivered correctly
  - Anonymously auction goods — without revealing any bids (except the winning bid) or bidders

Is anonymous computation feasible?

- Good news:
  - In theory: any computation can be anonymized
- Bad news:
  - In general, constructions are complicated
  - Most constructions multiply number of messages by a factor of at least 1000 (and often, much higher, like 10^{20})
  - Usually, simple IP location tracing (traffic analysis) reveals identity of parties
  - Computation requires complex crypto operations.
  - Running times for "simple" anonymous computations are usually measured in days or years.
- So researchers have relied on partial solutions
  - Mixes, pseudonyms, escrow

Mixes

- Use intermediate forwarding agents
- Examples: onion routing, crowds, anonymizer.com, etc.
- Idea simultaneously thought of by several researchers
- Problems:
  - intermediary knows all
  - subject to traffic analysis and statistical analysis
  - can not link old messages to new messages



Pseudonymous identity

- Establish a consistent, but disguised identity
- Example: mail forwarders
- Can disguise basic facts about identity, but may be traceable from patterns of use
- Once identity is revealed, then all previous uses are traceable

Escrow

- Use pseudonym, but store real identity where law enforcement can find it.
  - Refinement: split identity into multiple parts
  - Store them in different locations
- Depends on procedural mechanisms (e.g. search warrants) for privacy
- Has drawbacks of pseudonym
- Government approach to cryptography

Auction types

- Auctions
  - Allocate scarce resources
  - Proposed to ration Internet bandwidth
- Three types of auctions

English auction (price goes up)
  - advantages: encourages "honest" bids
  - disadvantages: slow
    not private

Sealed bid auction
  - advantages: constant time
  - disadvantages: does not encourage "honest" bids,
    auctioneer knows all

Dutch auction (price goes down)
  - advantages: protects privacy
  - disadvantages: slow
    does not encourage "honest" bids

Vickrey auction

- Vickrey gave a way to combine best features of English auctions and sealed-bid auction
- Second-price auction
  - Highest bidder wins
  - Price is the value of the second highest bid
  - Example: Alice is highest bidder for $100;
    Bob is second highest bidder for $80;
    Alice wins the bid, but pays only $80