CIS / TCOM 551
Networks and Computer Security

Lecture 24

Electronic Commerce

- Credit Card Transactions
  - Physical world requires a signature
  - Credit card companies charge merchant per transaction (usually $0.25)
  - Not good for small payments
- Digital Cash
  - Anonymity
  - Untraceability
  - Unforgeability
- Micropayments

Protocols

- EDI security: ANSI X12.58 or S/MIME.
- Secure Electronic Transaction (SET).
  - Visa and MasterCard.
- CyberCash.
  - Intermediary between Web-based merchants and credit card banks.
- CheckFree.
  - Electronic checks.
- First Virtual.
  - Credit card payments via email.

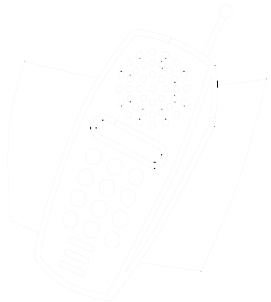
What is a “micropayment”?

(Slides adapted from talks given by Ron Rivest.)

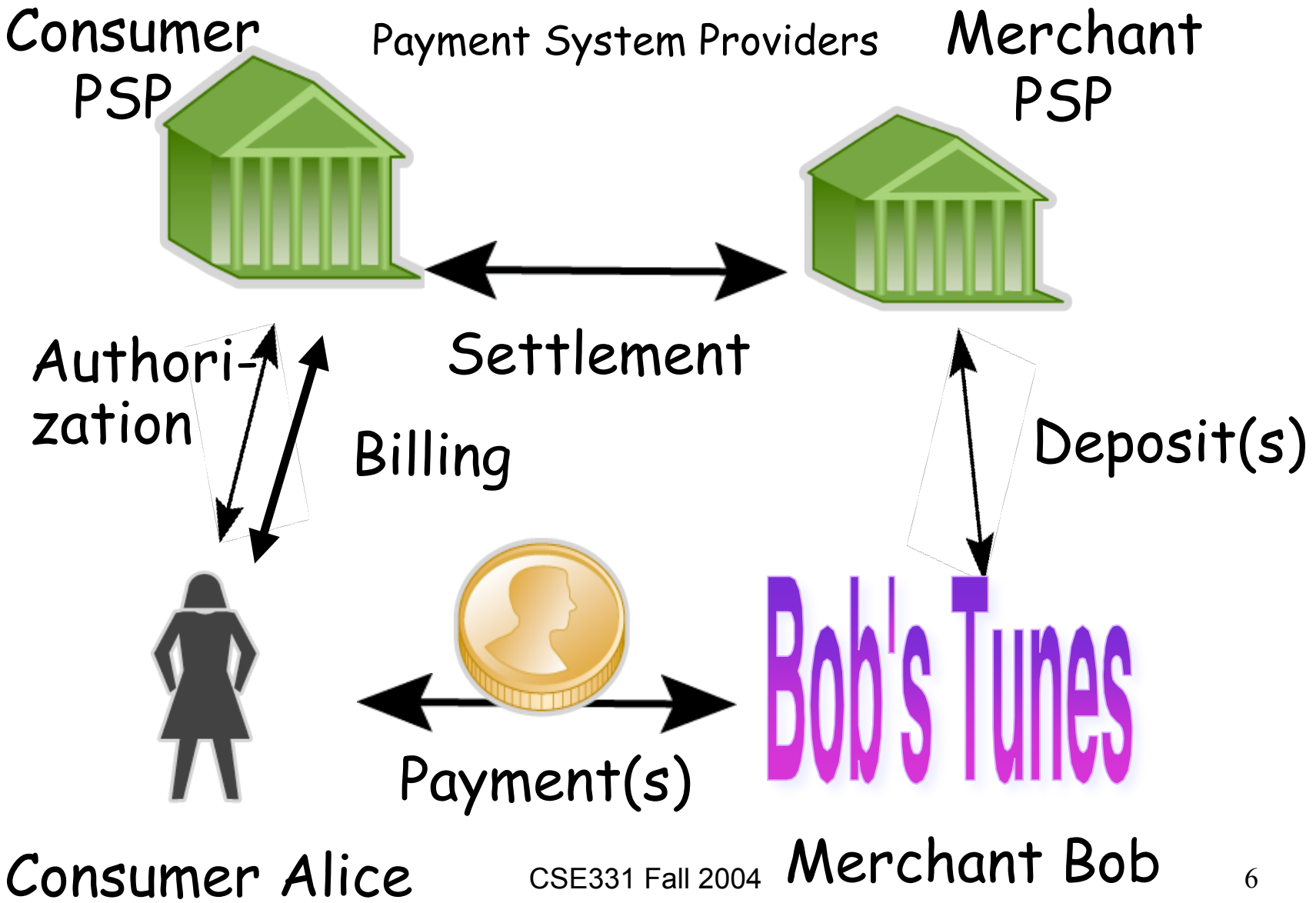
- A payment small enough that processing it is relatively costly.
  - Note: processing one credit-card payment costs about 25¢
- A payment in the range 0.1¢ to $10.
- *Processing cost* is the key issue for micropayment schemes.
  - There are other issues common to all payment schemes

The need for small payments

- "Pay-per-click" purchases on Web:
  - Streaming music and video
  - Information services
- Mobile commerce
  - Geographically based info services
  - Gaming
  - Small "real world" purchases
- Infrastructure accounting:
  - Paying for bandwidth



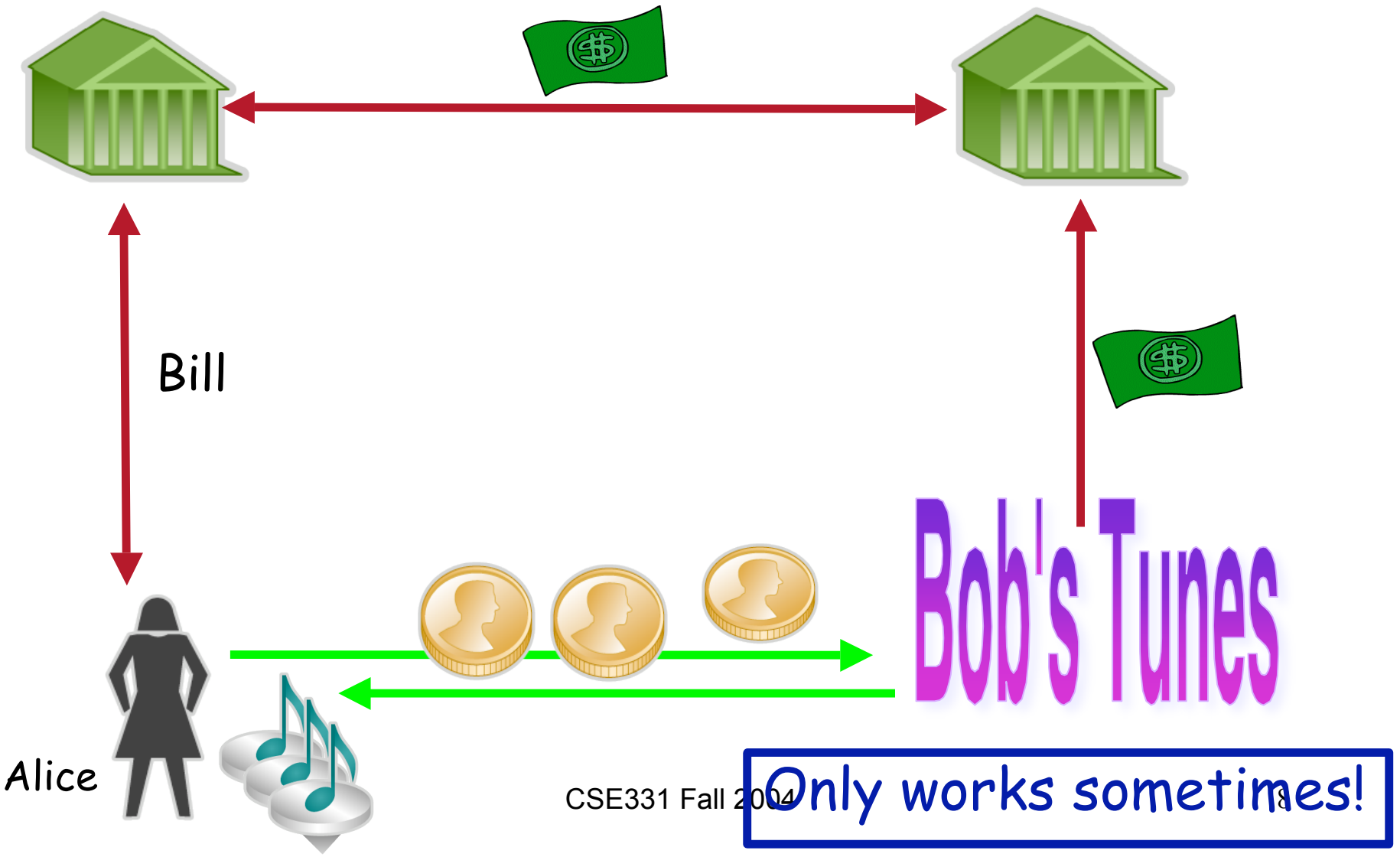
Generic Payment Framework



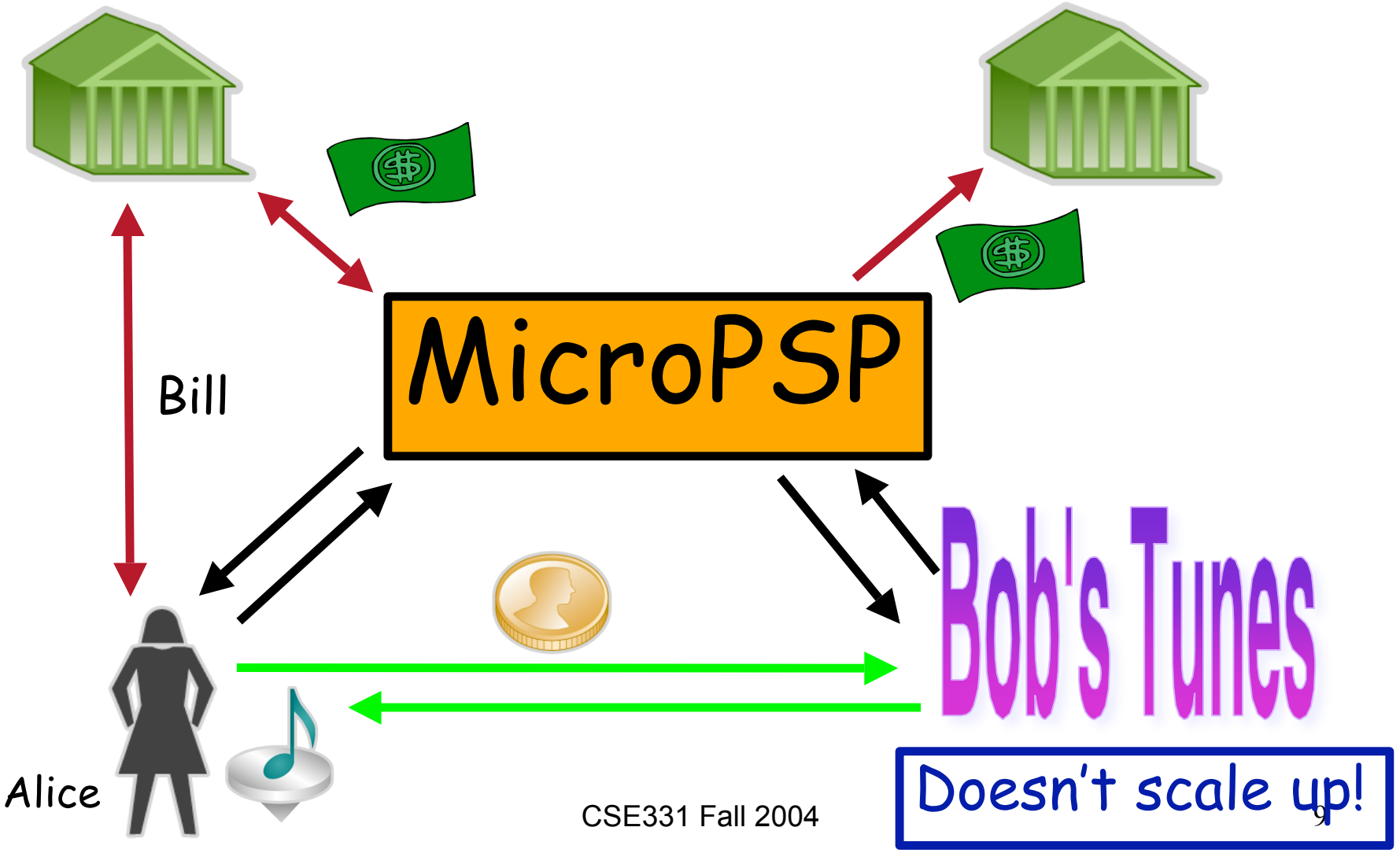
Aggregation

- To reduce cost, ***micropayments*** must be aggregated into fewer ***macropayments***.
- Possible levels of aggregation:
  - **None**: Every payment deposited with PSP
  - **Merchant-level**: A consumer's payments are aggregated by merchant
  - **MicroPSP**: Monopoly service that disintermediates existing payment services; doesn't scale well
  - **Universal**: Payments aggregated across all users and merchants, even those supported by different cooperating PSPs

Merchant-Level Aggregation



MicroPSP Aggregation



Universal Aggregation

- ***Universal aggregation*** dramatically reduces processing cost, independent of spending patterns.
- *Also called* ***many/many/many aggregation****:* Aggregates payments from
  - *Many* consumers
  - *Many* merchants
  - *Many* PSP's

  in any combination. No need to aggregate sales per consumer.

Universal Aggregation Idea

- Would merchant prefer:

  (a) twenty *50 cent payments*, or

  (b) *$0 for 19 payments, and $10 for one?*

  No difference to merchant, on average

Universal Aggregation Idea

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What if processing costs 20 cents per payment?

(a) nets only 30 cents per payment

(b) nets 49 cents net per payment!

Merchant strongly prefers (b) !

Electronic Lottery Tickets

- "Electronic Lottery Tickets as Micropayments" – Rivest '97

- Payments are *probabilistic*
- First schemes to provide global aggregation: payments aggregated across all user/merchant pairs.

“Lottery Tickets” Explained

- Merchant gives user hash value $y = h(x)$
- User writes Merchant check: “This check is worth $10 if three low-order digits of $h^{-1}(y)$ are 756.” (Signed by user, with certificate from PSP.)
- Merchant “wins” $10 with probability 1/1000. Expected value of payment is 1 cent.
- Bank (PSP) sees only 1 out of every 1000 payments.
- Merchant provides x as evidence for the Bank’s billing.

Peppercoin's Universal Aggregation

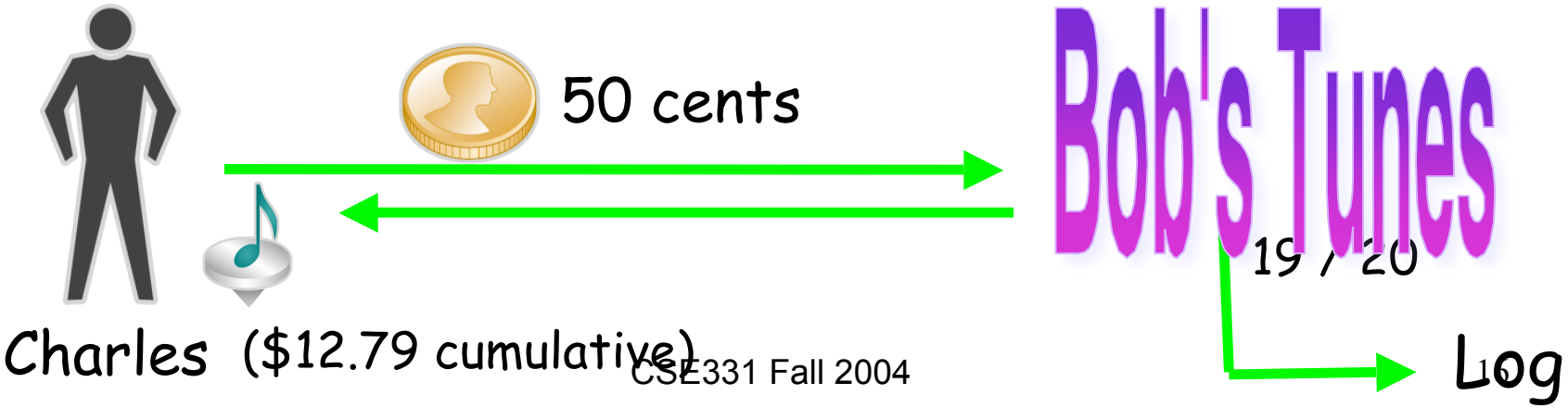
www.peppercoin.com

50 cents

Alice ($8.50 cumulative)

Log

Peppercoin's Universal Aggregation



Peppercoin's Universal Aggregation