

An Economic Model for Resource Exchange in Mobile Peer to Peer Networks

Present :
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Outline

- Introduction
- System Model
- Resource Types
- Producer-Paid Resources
- Consumer-Paid Resources
- Experimental Analysis
- Conclusion

Introduction – (1)

- Consider an urban area with thousands of vehicles
 - Drivers and passengers are interested in information relevant to their trip
- Using database stored at fixed site, It may have some potential drawback:
 - (1) responses may be outdated
 - (2) not real-time
 - (3) costly
 - (4) not robust

Introduction – (2)

- We explore a new paradigm that is based on peer-to-peer communications
- Advantages:
 - First ,better information accuracy ;especially for real-time information
 - Second ,cheap
less than a cent per day, even if the communication is through all day

Introduction – (3)

- Opportunistic peer-to-peer system
 - Transmission range
 - Resource propagation
- Two type of resources
 - Producer-paid resources
 - Consumer-paid resources
- Two incentive mechanisms for two type

System Model

- **Resource Model**
 - Spatial / temporal
- **Virtual Currency**
 - Virtual Currency = coin, it is bought by real money
- **Station to Vehicle Transmission**
 - There are fixed stations and moving objects in system
- **Vehicle to Vehicle Exchange**
 - When A meet B, A will buy resources that A is interested in from B

Resource Types

- **Producer-Paid Resources**
 - Resources which the owner is interested in **advertising** are producer-paid
 - Example: gas station , car breakdown , emergency
- **Consumer-Paid Resources**
 - Resources which the consumer is interested in **receiving** are consumer-paid.
 - Example: Available parking slots
- **Producer/Consumer-Paid Resources**

Producer-Paid Resources

- First setup Values

- A Producer can decide Initial budget **C** for R, and commission fee **f**

- How to incentive

- If A has the information R, and A encounters B
 - nothing happened (both have that information)
 - A **increase** its coin counter by f,
A sets its budget $(C - f) / 2$, and B does the same thing
- If $(C - f) / 2 < f$, then A and B stop transmitting R

Consumer-Paid Resources (1)

- Two Mode for Consumer-Paid Resources
 - Consumer
 - Pay for Resources
 - Broker
 - Take information of resource, but can not view it
 - Earn from other Consumers
 - Switch between two mode
 - When & Why

Consumer-Paid Resources (2)

- Price of a Resource

- $F(R) = -\alpha * t - \beta * d$ ($\alpha, \beta \geq 0$)

- t : time length since the creation of R

- d : the distance from the location of R

- α : constant

- β : constant

Consumer-Paid Resources (3)

- How should α and β be determined?
 - $PT = t + d/v$ (v is speed of vehicle)
 - Simply set the relevance is $-PT$ to $F(R)$
 - So that, $F(R) = -t - (d/v)$
 - $F(R) = -\alpha * t - \beta * d \quad (\alpha, \beta \geq 0)$
 - Depend on the two equations above,
 - We can set $\alpha = 1, \beta = 1/v$

Consumer-Paid Resources (4)

- Base on the relevance function ,the price is

$$P(R) = \begin{cases} E - (\alpha \cdot t + \beta \cdot d) & \alpha \cdot t + \beta \cdot d < E \\ 0 & \alpha \cdot t + \beta \cdot d \geq E \end{cases}$$

- E is the value of the resource to a consumer , when the parking slot becomes available.
- E , α , β may differ for different resources

Two “Paid” comparison table

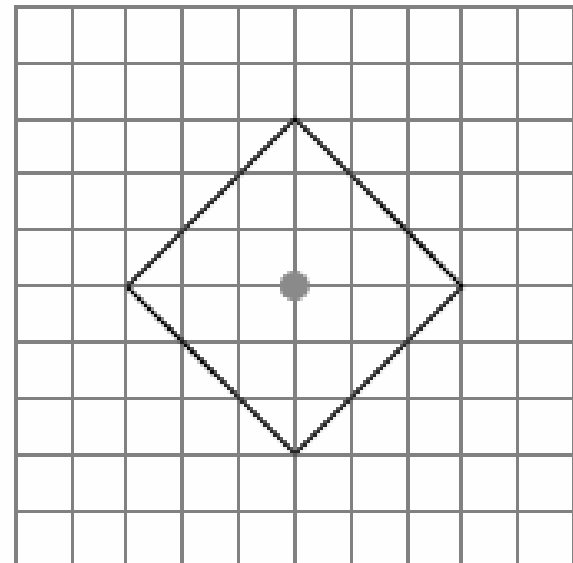
producer-paid	sender (A)
receiver (B)	A increases its coin counter by f and sets the budget of R to be $(C-f)/2$. B sets the budget of R to be $(C-f)/2$.

	consumer-paid	sender (A)
receiver (B)	consumer	B pays A $P(R)$
	broker	no payment

Both-Paid Resource

Experimental Analysis

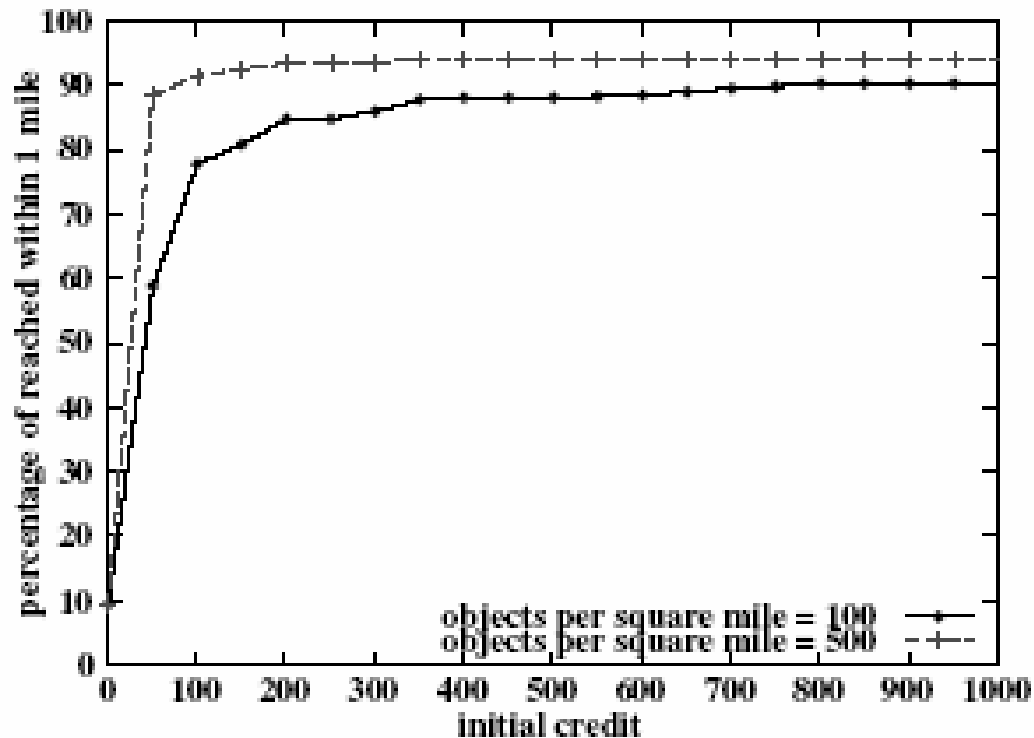
- **Simulation Setup (producer)**
 - **Parameters**
 - Traffic speed v
 - (v :10~50 miles/hour , +=10)
 - Transmission range r
 - (r :10,50,100,150,200 meters)
 - Traffic density g
 - (g :100,500 objects/mile*mile)
 - Diameter of coverage area d
 - (d :0.4~2.0 mile , +=0.4)



A coverage diamond area with diameter 6 blocks

Simulation results – (1)

- Percentage of reached vs. initial budget ($f=0.1$)



Other Parameters

$r = 50$ meters

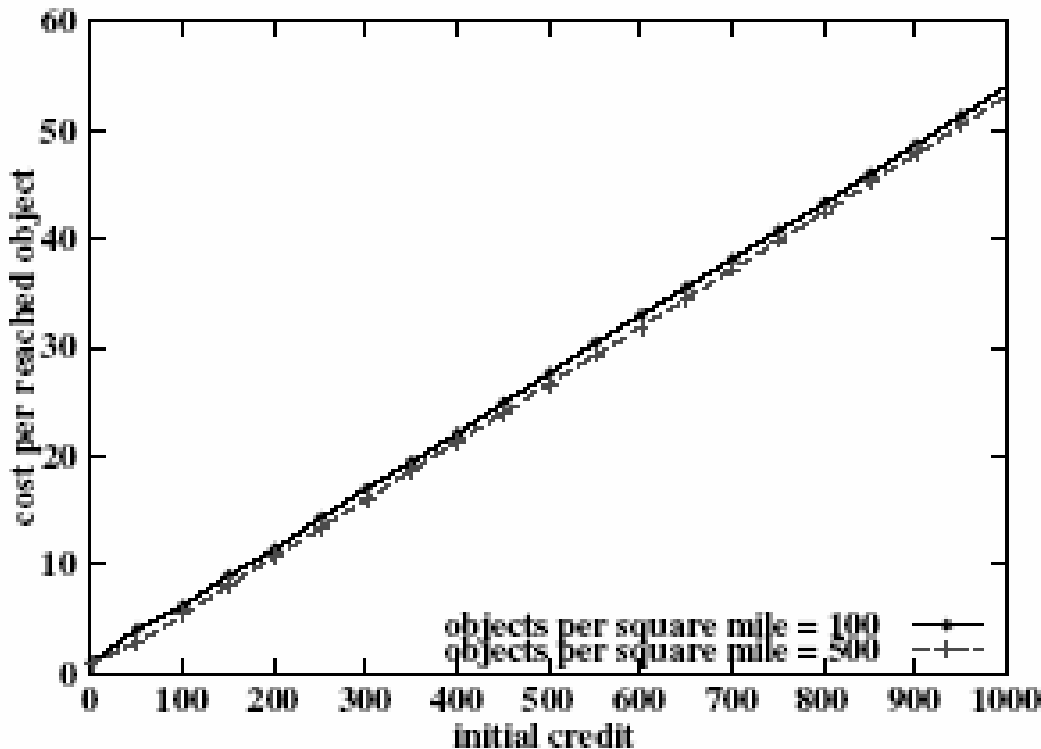
$v = 40$

miles/hour

$d = 2$ miles

Simulation results – (2)

- Cost per reached object



Other Parameters

$r = 50$ meters

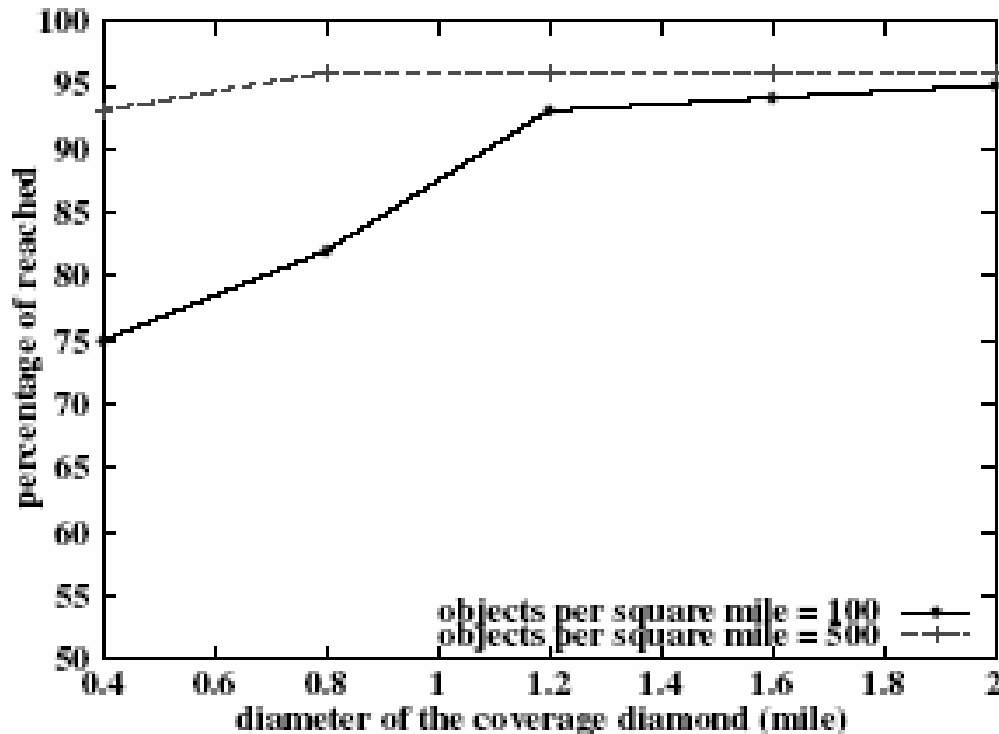
$v = 40$

miles/hour

$d = 2$ miles

Simulation results – (3)

- Impact of size of coverage area



Other Parameters

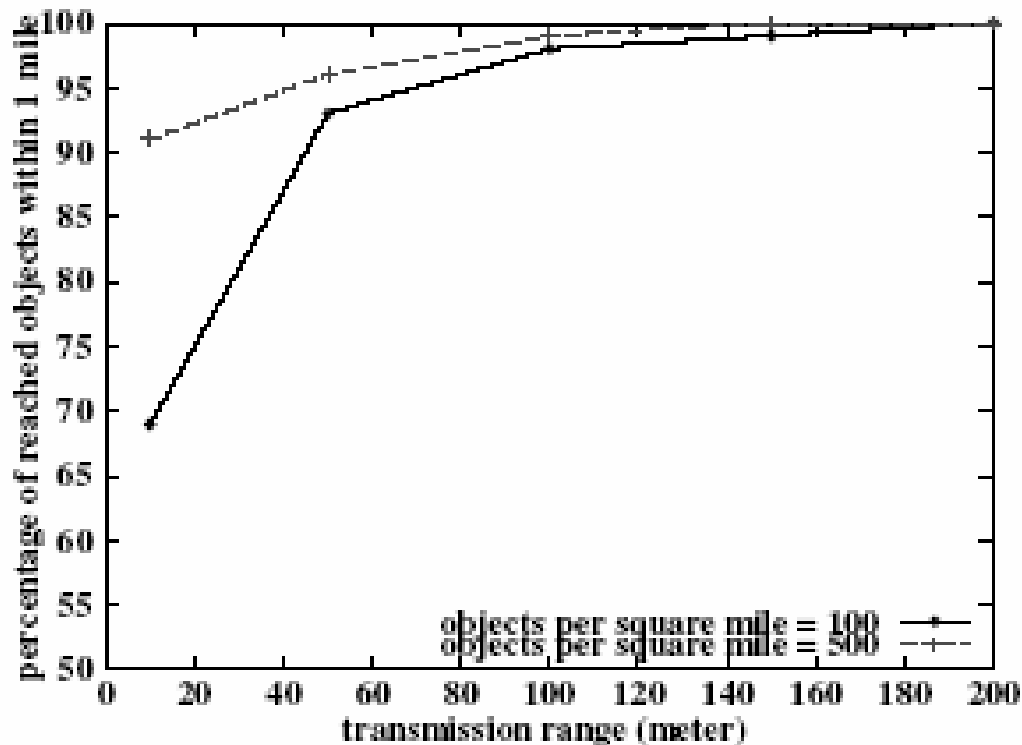
$r = 50$ meters

$v = 40$

miles/hour

Simulation results – (4)

- Impact of transmission range



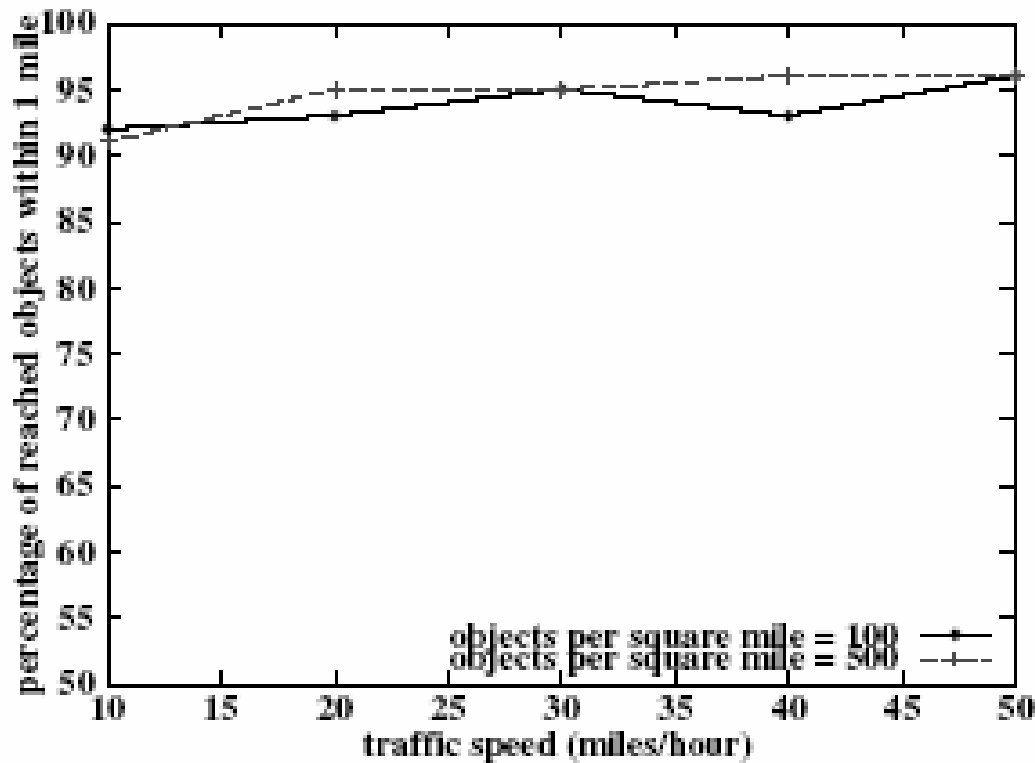
Other Parameters

$v = 40$
miles/hour

$d = 2$ miles

Simulation results – (5)

- Impact of traffic speed



Other Parameters

$r = 50$ meters

$d = 2$ miles

Analysis of Consumer-Paid policy

- **Blind search vs. information guided search**
 - **Blind search (BS):**
 - A consumer drives around the area, and he occupies the first resource that is available
 - **Information guided search (IGS) :**
 - Start with a blind search, until a resource is available, and he occupies it
 - Or get information from the system, resource R is available; if another R' is closer, he will go to R'
 - **Result**
 - The IGS search time is half of BS search time

Conclusion

- Peer-to-Peer system
 - For vehicle to exchange resources
- Two type of resources
 - Producer-paid resources
 - Consumer-paid resources
- Incentive mechanisms
 - For two types