Modeling Ad Hoc Network using Game Theory

Bingqian Li
5861362

GTFT

Solve: when to relay the request

Assumption:

time is slotted

relay is generated randomly between some node each time slot

the source requests the relay nodes in the route to forward its traffic to the destination

the traffic blocked if the relay node blocked

Modeling

Assuming:
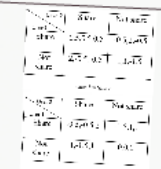selfish behavior vs. rationality

Result

(figure)

Solution

Trigger
-punishment if a user few relays

Repeated Game
- the greater the number of nodes in the network the higher the chances of achieving a desirable equilibrium

Algorithms in Repeated Game
-GTFT(general tit for tat)

Advantage

self-configing
users are free to join or leave

reduce the complexity of infrastructure

Each node in the network is capable of independently adapting its operation based on the current environment according to predetermined algorithms and protocols.

why we can model it using game theory

GTFT

Influencing Factors:

Number of nodes within class ?

Energy variation (Ei)

Number of frames filled with different Ei

Associated with the number of successful relay requests generated by the node to the number of relay requests made

If q is the number of relay requests sent by the node has a mix pair of type q it gives a

three-player peer-to-peer file sharing game

(matrix/table)

the only NE: (Not share, Not share, Not share)

Network Structure

(diagram)

What is Ad Hoc Network

Ad hoc for this I is Latin

wireless self dynamic existing infrastructure eg. Routers, Wan

instead, each node participates in routing by forwarding data to other nodes

based of network connectivity

Motivation

Network Design & Game Theory
-Modeling

The advantages of Ad Hoc Network
-Later

To improve the efficiency of a network
-hardware (engineer)
-software
 -design
 -algorithms
 -configuration
 -protocol)

Agenda

Motivation

Introduction

Modeling

GTFT algorithms

Result

Conclusion

Explanation

In wireless ad hoc networks, nodes communicate with far off destinations using intermediate nodes as relays.

Since wireless nodes are energy constrained, it may not be in the best interest of a node to always accept relay requests.

On the other hand, if all nodes decide not to expend energy in relaying, then network throughput will drop dramatically.

Contradiction:
individual energy constraint VS network efficiency

Result
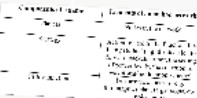
After complicated statistically proof(in paper), it prove that:

the GTFT algorithms based on the assumption before provide a NE state.

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Contribution

Modeling the Ad Hoc Network using Game Theory Nash theorem to analyze the peda metrics

Using GTFT algorithm to get a NE

Thank you!

GTFT

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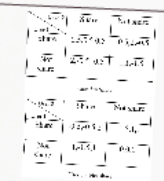selfish behavior vs. rationality

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three-player peer-to-peer file sharing game

the only NE: (Not share, Not share, Not share)

What is Ad Hoc Network

Ad hoc for the 1 in Latin

interconnected system joining infrastructure e.g. Routers, Hosts

a network each node adapt its own operating by themselfing data to other nodes

based on network topology

Network Structure

GTFT

Influence Factors

Number of nodes within class n

Energy constraint ED

Number of classes dealt with different D

Normalized Acceptance Rate (Rate) the ratio of the number of successful relay requests generated to the node to the number of relay requests made

g(q,D) the number of relay requests sent by node n in a network of type D, time t

Motivation

Network Design & Game Theory
- Prisoner's Dilemma

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- hardware (hrogineer)
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Motivation

Network Design & Game Theory
-Modeling

The advantages of Ad Hoc Network
-later

To improve the efficiency of a network
 -hardware (engineer)
 -software
  -*design*　■
  -*algorithms*
  -configuration
  -protocol

What is Ad Hoc Network

Ad hoc(for this) in Latin

-does not rely on a pre-existing infrastructure
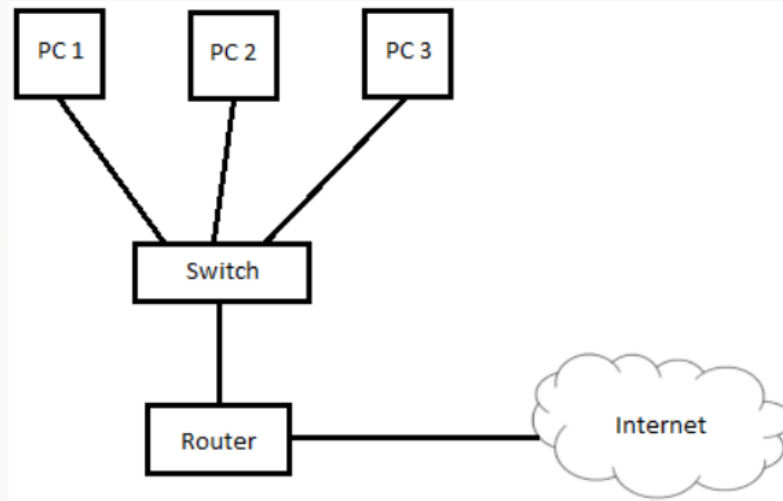-eg. Routers, Vlan

Instead, each node participates in routing by forwarding data for other nodes,

based of network connectivity

Network Structure

Advantage

self-configuring
  users are free to join or leave

reduce the complexity of infrastructure

Each node in the network is capable of
independently adapting its operation based
on the current environment according to
predetermined algorithms and protocols.

-why we can model it using game theory

Modeling

Components of a game	Elements of an ad hoc network
Players	Nodes in the network
Strategy	Action related to the functionality being studied (e.g. the decision to forward packets or not, the setting of power levels, the selection of waveform/modulation scheme)
Utility function	Performance metrics (e.g. throughput, delay, target signal-to-noise ratio)

Assuming:
selfish behavior vs. rationality

the
ieving a

three-player peer-to peer file sharing game

User 2 / User 1	Share	Not share
Share	0.5,0.5,0.5	-0.5,2,-0.5
Not share	2,-0.5,-0.5	1,1,-1.5

User 3 = Share

User 2 / User 1	Share	Not share
Share	-0.5,-0.5,2	-1.5,1,1
Not share	1,-1.5,1	0,0,0

User 3 = Not share

the only NE: (Not share, Not share, Not share)

Explanation

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GTFT

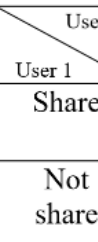Solve: when to relay the request

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three-play

	Use
User 1	
Share	
Not share	

User 2

Influence Factor:

Number of node: $n(i)$ in class i

Energy constraint: $E(i)$

Number of classes: K(each with different E_i)

Normalized Acceptance Rate (NAR) :
the ratio of the number of successful relay
requests generated by the node, to the
number of relay requests made

$B(h,j,k)$: the number of relay requests made
by node h for a session of type j till time k

After complicated statistically proof(in paper), it prove that:

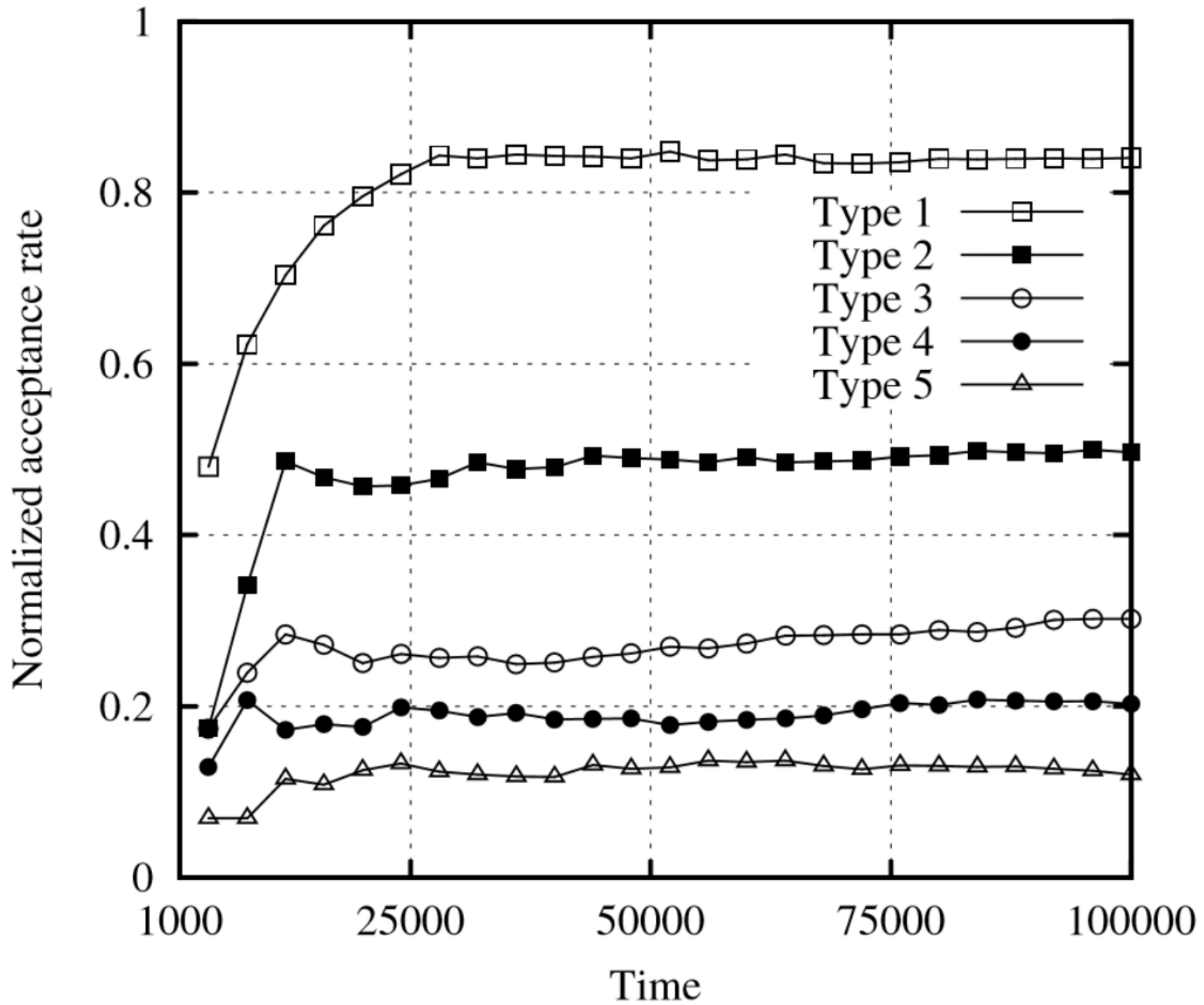the GTFT algorithms based on the assumption before provide a NE state.

Fig. 2.   NAR versus time when $N = 25$, $K = 5$, $q(1) = 1$, $M = 1$, and all nodes employ GTFT. NAR values converge to the optimal operating point.

Contribution

Modeling the Ad Hoc Network using Game Theory tools that can be analyze the performance.

Using GTFT algorithms to get a NE

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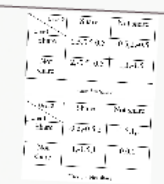selfish behavior vs. rationality

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Network Structure

What is Ad Hoc Network

Ad hoc for this I is I-able

interconnected set of nodes deleting infrastructure e.g. Routers, Hubs

Ad hoc each node establishes communicating by forwarding data to other Nodes

Based on wireless channels today

GTFT

Influential Factors

Number of Users n(Time slots)

Energy constraint (E)

Number of Chances share with different (D)

Normalized Acceptance Rate Ratio
the ratio of the number of successful relay requests generated to the node, to the number of relay requests made

θ(q,t) the number of relay requests sent by node n face a length of type i at time t

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