



Funded Project Final Survey Report

Principal Investigator: Prof Balaji Prabhakar

Project Title: An Incentive Mechanism for Reducing Congestion-related Costs in Transportation Systems: A pilot program in India

1. Project Description:

The proposal outlines a general approach for influencing the behavior of commuters by incentivizing them to travel at times of low congestion. Our goal is to reduce congestion-related costs (fuel, pollution, time) and, ultimately, to reduce congestion itself.

At its core, the proposal concerns an incentive mechanism to change the commuting patterns of a large population of commuters who are part of a pilot program in Bangalore, India. However, our ideas are generalizable to a wider context; indeed, one of our main goals is to extend our pilot program to address congestion in Bangalore and elsewhere.

A salient feature of our approach is its use of ideas, such as congestion management, incentive mechanism design, and distributed measurement which have proved very effective in ensuring the simplicity and scalability of the Internet over the last two decades.

Our proposal addresses the Bangalore congestion problem. We begin by considering the problem of reducing the maddeningly long commutes to Electronic City by the IT community. Electronic City is located about 15 km south of Bangalore and hosts IT giants such as Infosys Technologies, Wipro, Hewlett Packard, Tata Consultancy Services, Siemens, Satyam Computers and Tata Power. An entity, called the Electronic City Industries Association (ELCIA), of which these companies are members, oversees the development of Electronic City. We have initiated a project with Infosys, with the aim extending it to all of ELCIA.

A persistent problem. Extensive and detailed data maintained by Infosys shows that commuters who leave for work after 7.30am suffer commute times that are 1.5 times longer when compared with those who leave before 7.30am. This translates to any extra 45–60 mins extra commute time every day! In addition there is the cost of pollution due to emissions and noise, and the cost of extra fuel. The huge time and fuel costs haven't deterred commuters.

Incentive mechanism. In order to unilaterally incentivize commuters to arrive early, we have proposed an incentive scheme whereby those who come late pay a very small "charge" and the total collection of charges is given away to those who come early in the form of "rewards." This method is a zero sum game, similar in spirit to Carbon Credits and to Congestion Pricing in the Internet. Basically, those commuters who are "in-profile" (arrive early) collect money from those who are "out-of-profile." Over the long term the incentive compatible nature of the scheme will have the effect of shifting more commuters to earlier arrival times.

Energy efficiency significance. Reducing fuel consumption due to traffic congestion has a direct impact on energy efficiency. Methods include decongesting, encouraging carpooling, encouraging better utilization of vehicles so that the number of vehicles can be reduced.

Research Activities: Developed and implemented an incentive mechanism to reward 14,000 employees at Infosys Technologies, Bangalore, India to commute in off-peak times. The goal was to reduce commuting times and congestion costs like excess fuel use.

Major Findings: A paper presented at Network Economics Workshop in July 2009 describes the major findings. The most important feature is that our scheme was successful in moving commuters to the off-peak hours: the number of off-peak hour commuters increased to around 9200 from around 4500 during a 6 month period. Further, the company chartered buses were better load balanced and, hence, less congested during peak times (more free seats and comfortable rides). The paper discusses all the details and statistics.

2. How have the results from this project contributed to the solution of energy efficiency challenges? How is it likely to contribute to solutions in the future?

Fuel is wasted by vehicles stuck in traffic jams. It was estimated by the Texas Transportation Institute that about 3 billion gallons of gasoline is wasted annually in this fashion. This is equal to the total amount of gasoline consumed in the U.S. over a six day period! By reducing congestion, one can save this staggeringly large wastage of fuel. Of course, there are other costs, such as pollution/emissions and wasted time which are in addition to the fuel waste and these can also be reduced by reducing road congestion.

3. What undergraduate or graduate students, as well as Post-Doctoral fellows, were involved this project. How were they involved? Please list their name, classification and a short description of their involvement.

Deepak Merugu, EE PhD student. He worked on the entire project: analyzing the historical data, helping devise the incentive mechanism, building web interfaces and other bits of technology related to the 6 month deployment of scheme, analyzing the results, conducting surveys, and, finally, writing the paper. He lived in India for a 6 month period on the Infosys campus while the scheme was deployed.

Naini Gomes, MS&E M.S. student. She helped with analyzing data and co-ordinating execution of the project with Deepak and Infosys transport committee folks over the phone.

4. Will you be continuing work on this project? How and with whom? Please include any comments.

We are discussing the further implementation of the scheme at Infosys, given that there is some new construction on the road leading up to Infosys and there is a push to having commuters take the public transport system. The question is: how can commuters be incentivized to adopt public transportation. It is exceedingly difficult for the company to provide adequate parking and the tolls on the newly constructed bridge are so large as to make the running of chartered buses too expensive.

5. Are you seeking or have you received additional funding as a result of this project, or for continued work on this project? Please list the amount you are seeking/have received, source of the additional funding and a short description.

No.

6. Has this project generated any other projects? *Please describe.*

There is a Stanford University decongestion project that has resulted from the Infosys pilot (i.e. this project). The Stanford project will be funded by the U.S. Dept of Transportation. Other projects in the U.S. and elsewhere are under discussion.

7. What patents, if any, have you received or applied for?

None.

8. Please list all academic and non-academic (Op-Eds, news magazines, etc) publications and conference presentations as well as articles in progress that came about as a result of this project. May we post these on the PEEC website? *If so, please list the URL or provide a pdf version.*

Three newspaper articles (e.g. front page of The Times of India, etc). These articles have been posted on the PEEC website.

9. Provide a URL address for any websites that provide more information for interested parties on your research project, including photos and videos. We will add this information to your project summary on the PEEC website.

<http://www.stanford.edu/~balaji/societalnetworks.html>

10. Have you developed any specific products, (such as databases, physical collections, educational aids, software, etc), as a result of this project? *If so, please list along with a short description.*

11. Were any undergraduate or graduate courses generated as a result of this project? *If so, please list the course title and a short description.*

Part of the material of EE 24N, an Introductory Seminar with the title "Incentive Mechanisms for Societal Networks", is about this project and a more general congestion-related discussion.

12. Have you provided any information regarding your research to any public or private institutions (e.g., legislative briefing, government panel, congressional testimony, corporate presentation) or any public or private institution asked you for information regarding your research? *If so, please list the organization, date and a short description.*

13. Have you partnered or worked with businesses, governmental agencies, NGOs, or other public or private organizations in connection with your project? If so, what role have they played? Please list the institutional name, type of institution and a short description of the partnership.

Yes, Infosys Technologies. The company not only approved this rather intensive (perhaps invasive) project, but it made available various key facilities like web interfaces to employees, advertisement of the project, commuter data, money for paying out weekly incentive rewards, interfaces with the employee payroll system

for paying the rewards, etc. Overall, we were very impressed with the inspired leadership at the company and the excellent collaboration.

14. What public education activities have you undertaken in conjunction with this project?

In addition to interviews for the press articles, I have given a number of public lectures on this topic at places like The Indian Institute of Management, Bangalore; Chulalongkorn University, Bangkok; National University of Singapore, Singapore; various industry research labs; and various departmental seminars at Stanford.