OneClick: A Framework for Capturing Users' Network Experiences

Cheng-Chun Tu[1], Kuan-Ta Chen[2], Yu-Chun Chang[3], and Chin-Laung Lei[3]
[1]Stony Brook University, [2]Academia Sinica, [3]National Taiwan University

Motivation

- How to capture users' perceptions when they are using network applications?

Network Application	Delay Jitter	Loss Rate	User Satisfaction
1	Small	High	?
2	Large	Low	?

Which network configuration is better from users' perception?

Network Topology

Router:
- Automatically change the network settings every 10 seconds
- For each setting, randomly set the network delay within (0, 2000) ms and loss rate within (0%, 20%).

Sender & Receiver:
- A song is played by the sender host, transmitted to the receiver via AIM or MSN Messenger.

Contribution

- Present a lightweight, non-intrusive, and efficient framework called OneClick to learn about users' experiences in using network applications
- Demonstrate the effectiveness of assessing the users' perceptions under different network factors.

Methodology

User experiments

- Ask users to click a button whenever you feel dissatisfied with the quality
- Users do not need to be well-trained to participate as only an intuitive click action is required.

Data analysis

- Apply Poisson regression to model the relationship between network factors and the click rate (average number of times the subject clicks the button in one second)
  - Predictor: click rate
  - Dependent variable: network factors
- Assume the click rate is C(t) and the network factors are $N_1(t)$, $N_2(t)$, . . . , $N_k(t)$ at time t. Then, the Poisson regression equation is:

$$\log(C(t)) = \alpha_0 + \alpha_1 N_1(t) + \ldots + \alpha_k N_k(t), \qquad (1)$$

where α_i denotes the Poisson regression coefficients, which are estimated by the maximum likelihood method

Users' delay response

- Problem: users may unintentionally delay the click actions after they become aware of the degraded application quality
- Solution: shift the click event process and search for the average delay time d_{avg} by fitting the regression model for network factors and click event processes with different time lags
- d_{avg} is computed as:

$$argmin_d\{\text{deviance of (1) by replacing C(t) with C(t+d)}\}$$

- After obtaining the best model fit, we compute the expected click rate as:

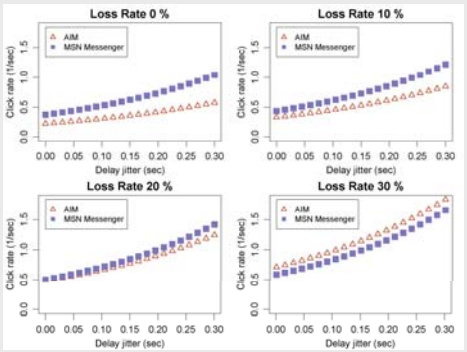
$$exp(\beta_0 + \beta_1 N_1 + \ldots + \beta_k N_k),$$

where β_i is the Poisson regression coefficients by fitting $C(t + d_{avg})$ with N_i, $1 \le i \le k$

Experimental Setup

- A song is played by the sender host, transmitted to the receiver via AIM or MSN Messenger, and played on the subject's earphone attached to the receiver host
- Subjects: three computer science students to perform the experiments, where each experiment lasts for 6 minutes

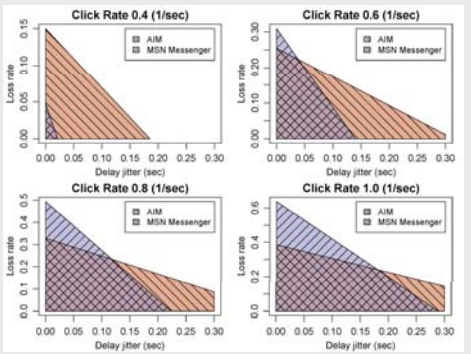
Result: Expected Click Rate



- Loss rate < 20%: MSN leads to a higher click rate
- Loss rate ≥ 30%: AIM leads to a higher click rate
- AIM is less tolerant of an extremely high packet loss rate than MSN Messenger, even though it is more tolerant at low packet loss rate

Result: Comfort Regions

- "comfort region": the set of network scenarios that leads to an expected click rate lower than a certain threshold



- Threshold = 0.4 or 0.6: AIM is better (larger comfort regions)
- Threshold = 0.8 or higher: Comparable
  -- MSN Messenger is more tolerant of packet loss and AIM is more tolerant of network delay jitters

Multimedia Networking and Systems Lab
Institute of Information Science, Academia Sinica
http://mmnet.iis.sinica.edu.tw