UNDERSTANDING INTERNET USAGE AND NETWORK LOCALITY IN A RURAL COMMUNITY WIRELESS MESH NETWORK

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OUTLINE

- Internet in Rural Area of Thailand
- Community Network
- TakNet CWMN
- Social Interview
- Traffic Measurement & Data Analysis
- Discussion and Takeaways

INTERNET IN RURAL AREA OF THAILAND

Thailand's Internet Penetration **28.92%** *ITU -D*

ranked 6th in AEC, as of 2014

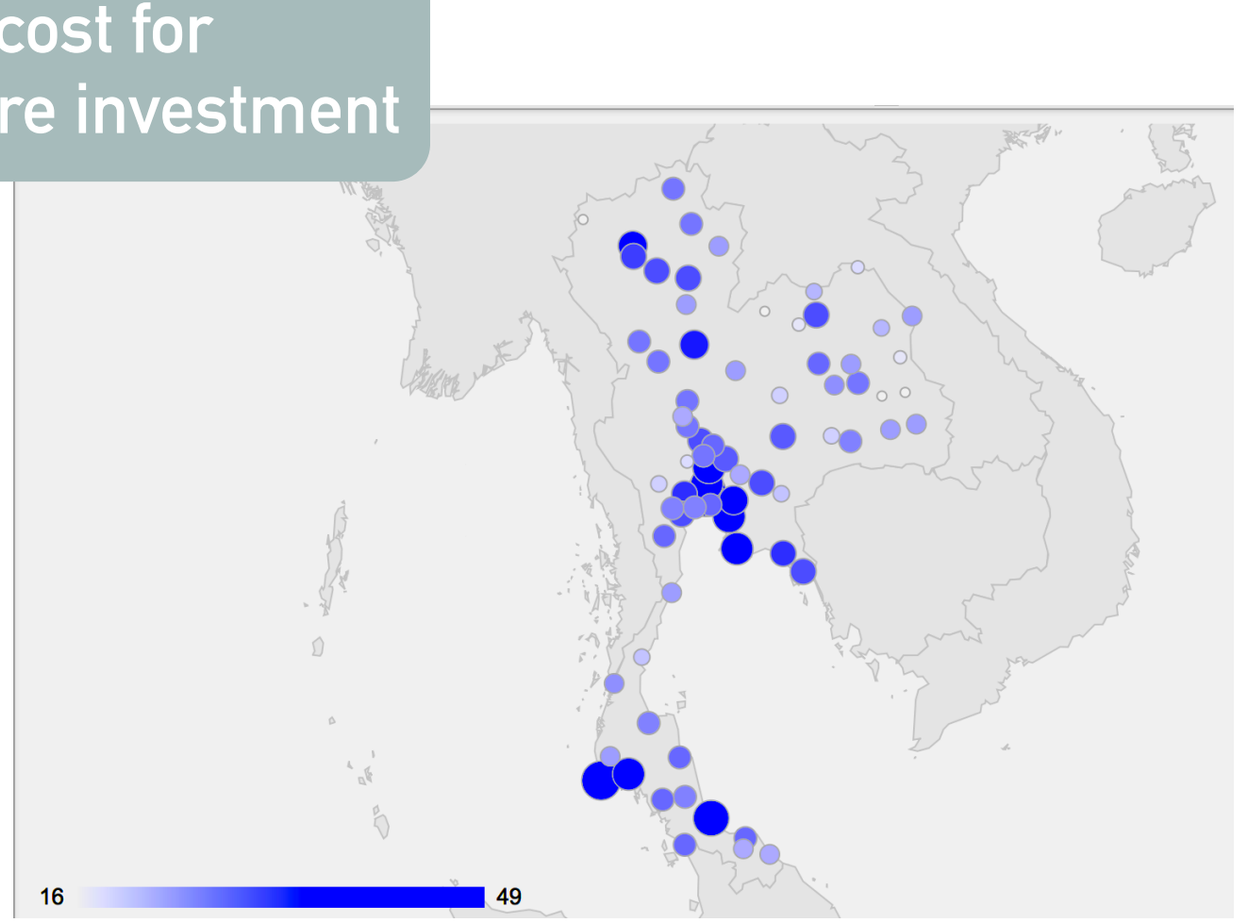
Low demand of using Internet

+

High cost for infrastructure investment

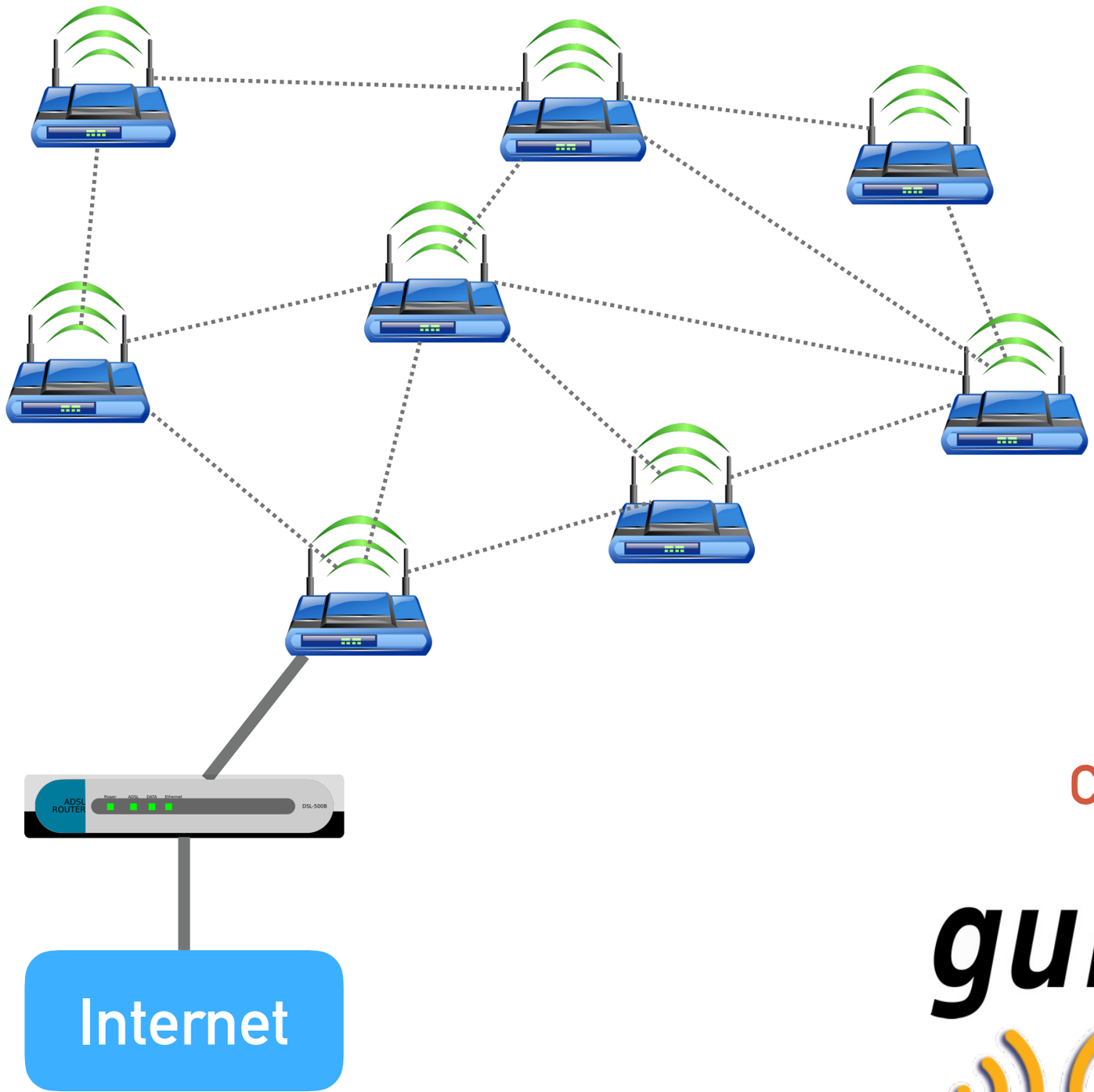
It is not cost-effective for ISP to invest network infrastructure

Digital Divide



Thai National Statistical Office, http://web.nso.go.th/

COMMUNITY NETWORK



Wireless ad-hoc network sharing the Internet gateway

Successful Community Networks !

guifi·net

freifunk.net

AWMN

FUNKFEUER FREE NET

TAKNET CWMN

Thai Samakhee
a small rural village in northern Thailand
50 households with 300 population

Before 2013

2 ADSL links provided by ISP

28$/month for a subscription

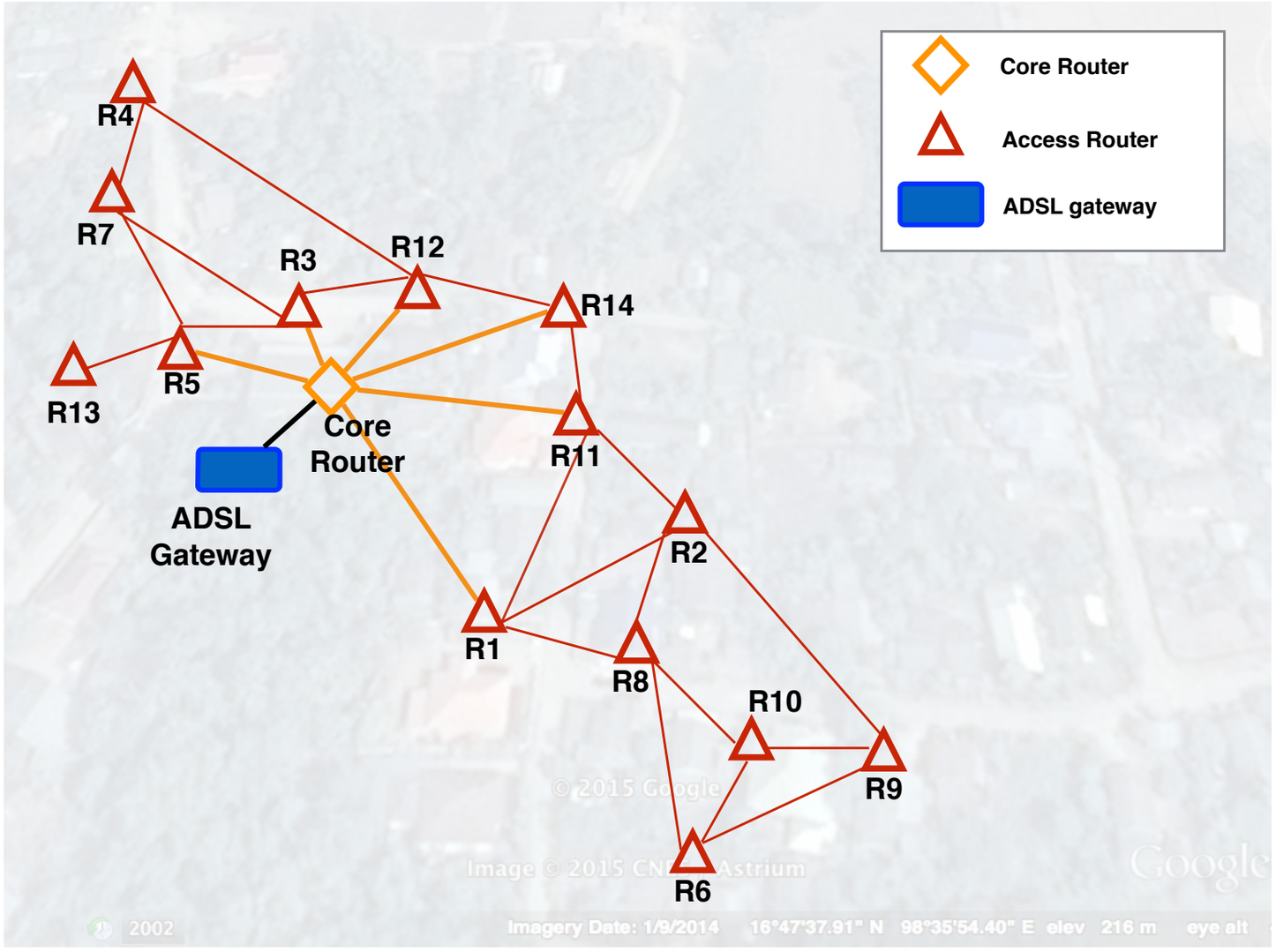
TakNet CWMN

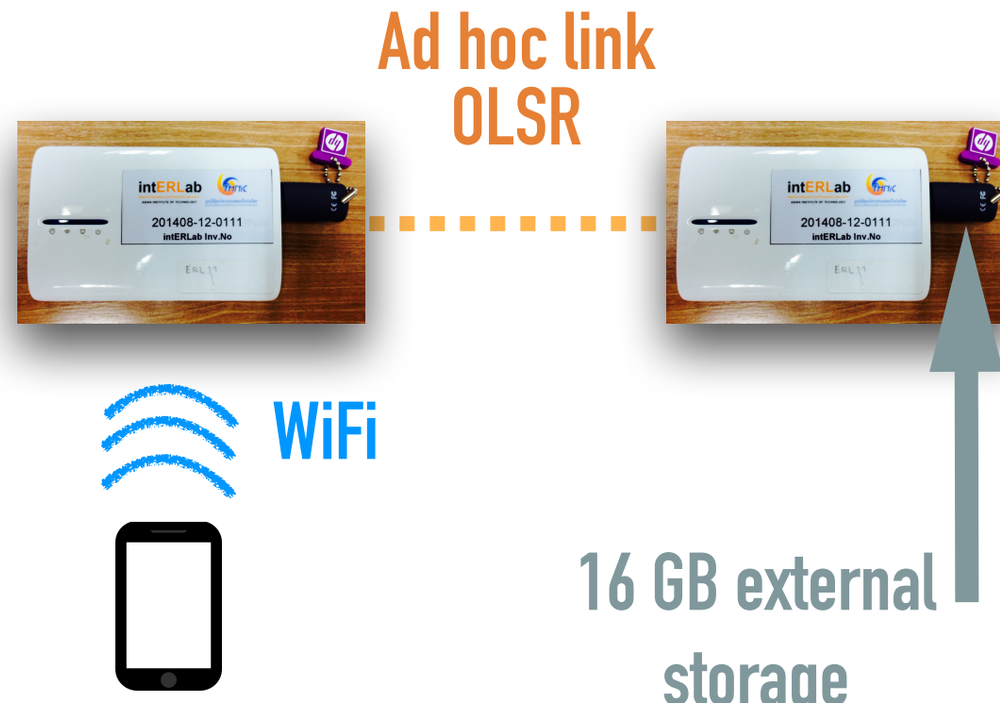
Internet cost is shard among villagers

5$/month for a subscription

Attract villagers to use the Internet

TAKNET CWMN





16 GB external storage

14 access routers (TPlink MR 3040)

1 core router (Unifi UAP)

OpenWrt, Attitude Adjustment 12.04

UNDERSTANDING THE INTERNET USAGE

Traffic Measurement

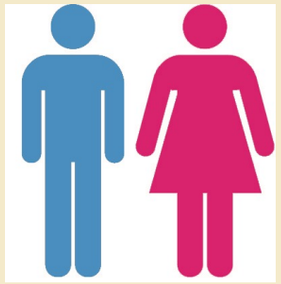
- Lightweight measurement
  - Traffic volume
    - *ifconfig* - 60 sec interval
  - Internet usage
    - *tcpdump* - HTTP request
    - Filter out the URL

Social Interview

- Well-defined questionnaire
  - Personal information
  - Typical usage
  - User feedback
- 30 mins interview
  - Free-style conversation

SOCIAL INTERVIEW

User information



18 34

52 interviewees

Kids 8-16

Teens 16-21

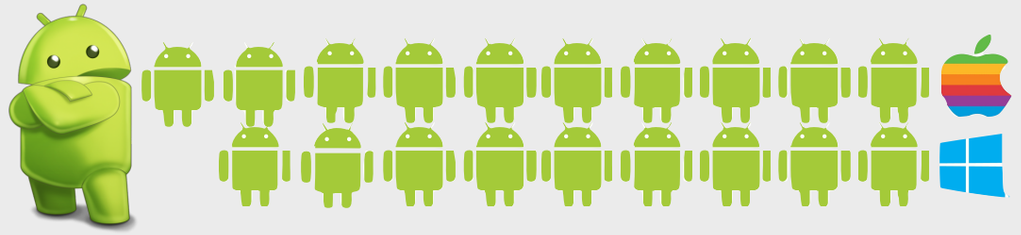
Adults over 22

Monthly wages

140$ - 560$

Device used

40%  VS  60%

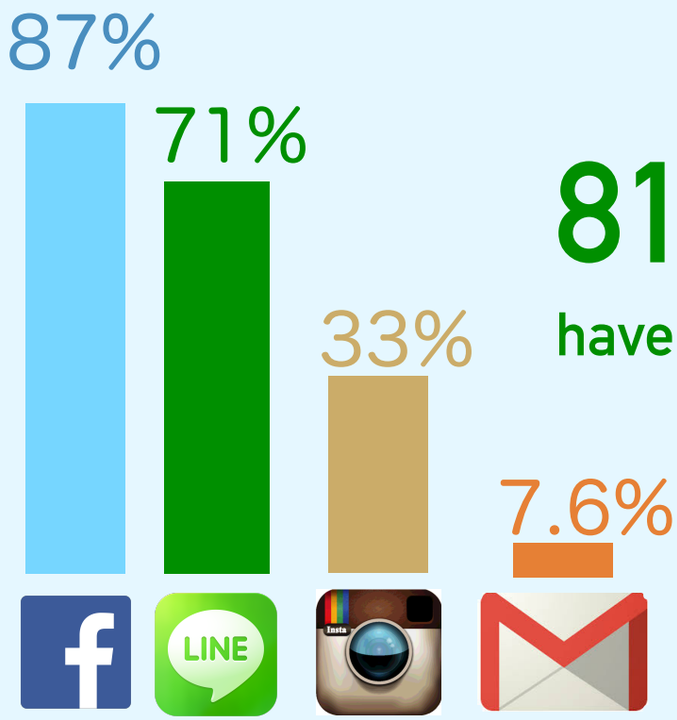
91% 

Popular content

Adults	JOBS, Training, Google, YouTube
Teens	Dek-D www.dek-d.com, Google, YouTube
Kids	Animal Jam, Google, YouTube

SOCIAL INTERVIEW

Social Communications



81% of Line users
have local contacts within the same village

10-20% of messages
exchanged among local users

User feedback

85% of users install CM battery application
(expect to improve their WiFi speed)

4 users opted out due to the extra cost incurred by electricity bill (just 1-2$/month)

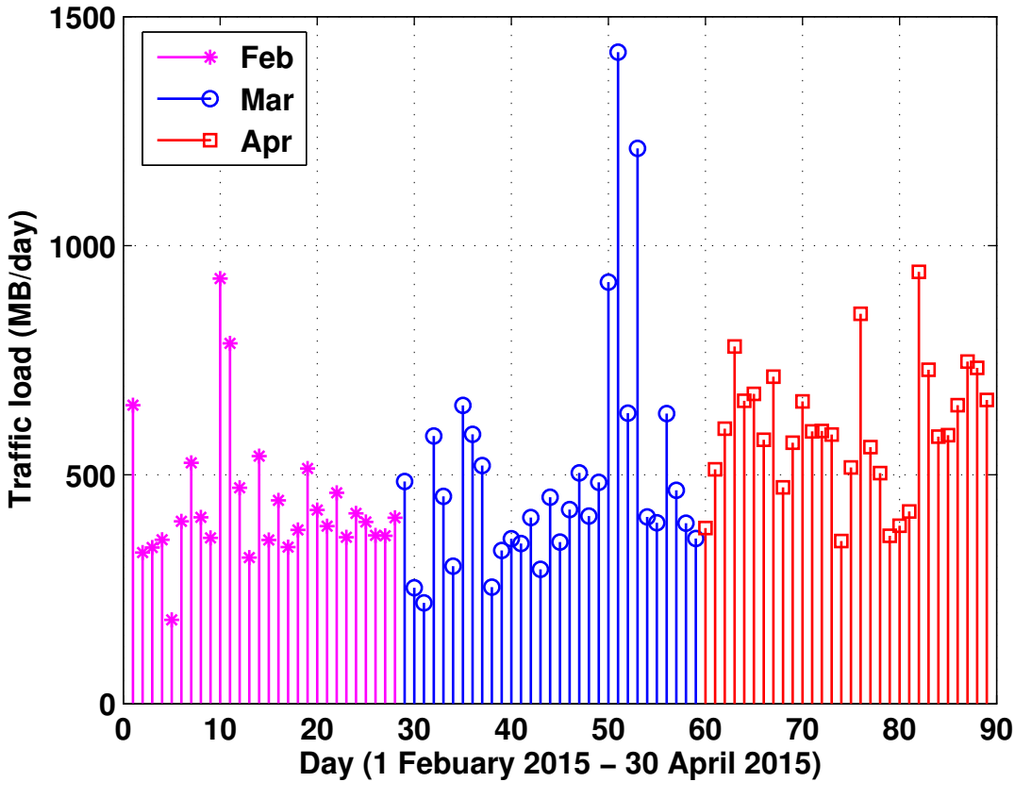
Usage pattern

30%	06:00 - 12.00
21%	12:00 - 17.00
80%	17:00 - 22.00
12.5%	22:00 - 06.00

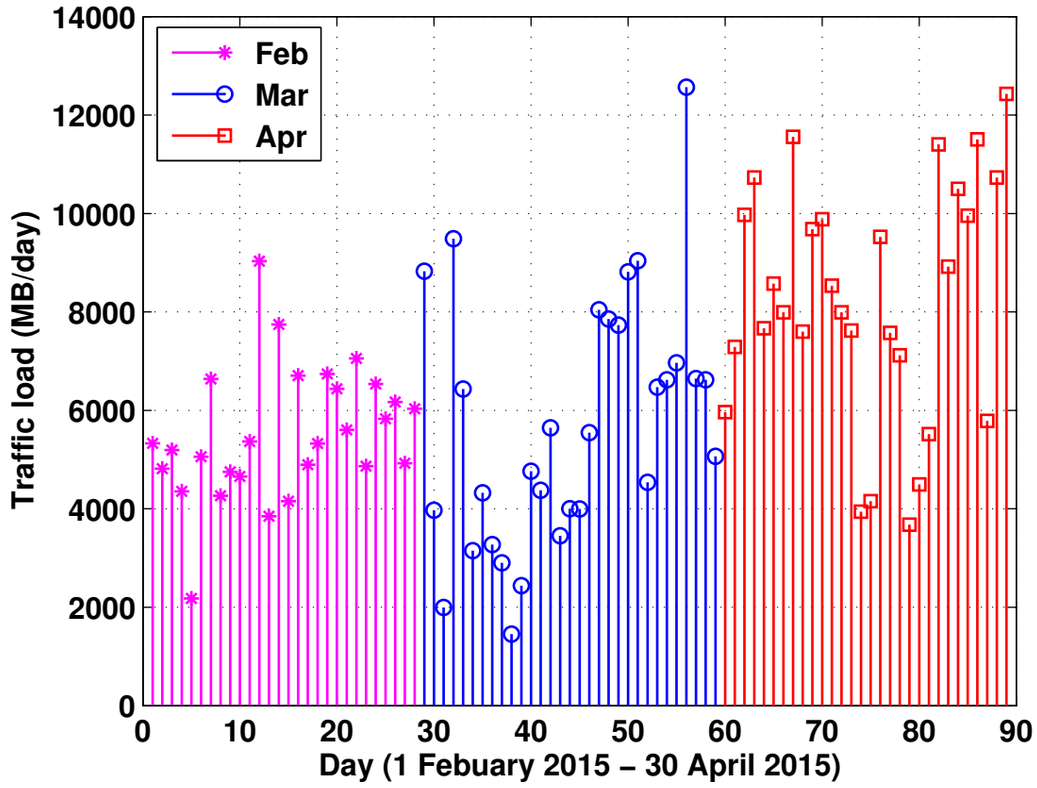
4 hours per day
on Internet usage

TRAFFIC USAGE

Upload



Download



Traffic Growth	Feb - Mar 15	Mar - Apr 15
Upload	25%	20%
Download	28.9%	15%

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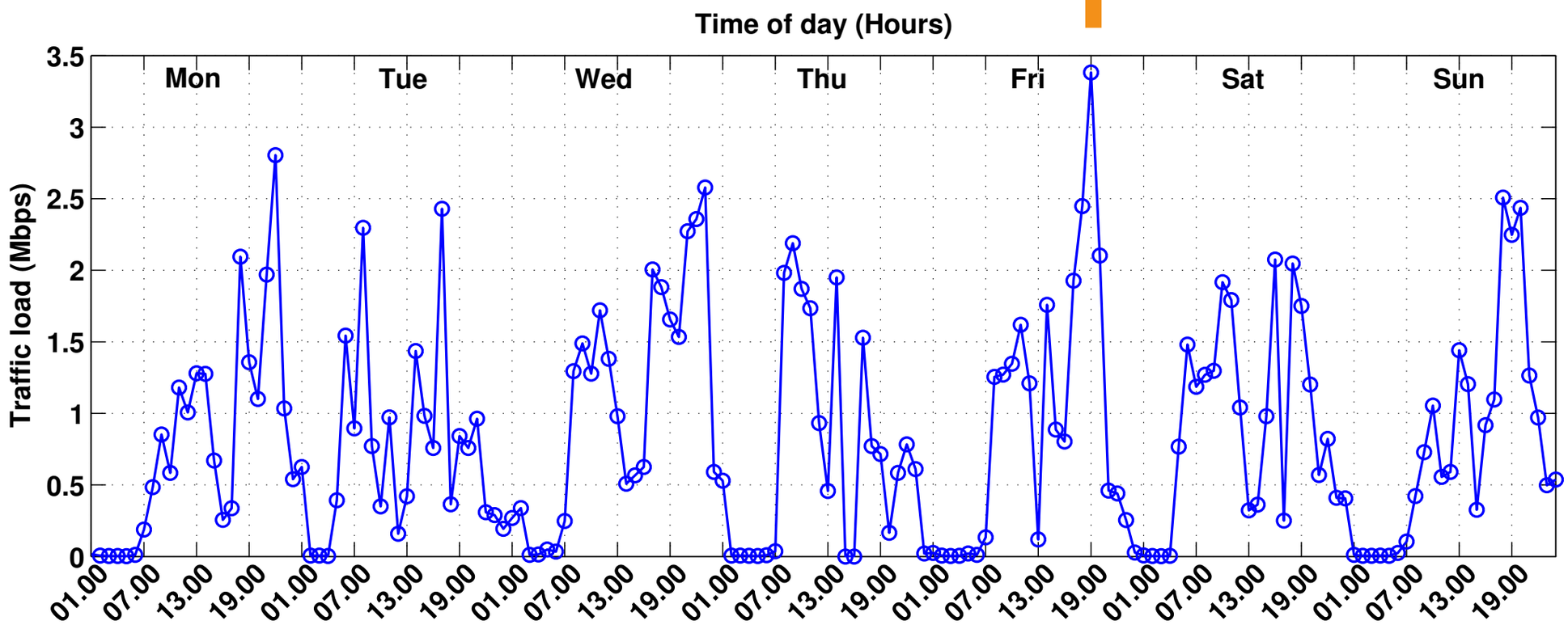
TRAFFIC USAGE PATTERN

Traffic almost reached the committed speed (4Mbps)



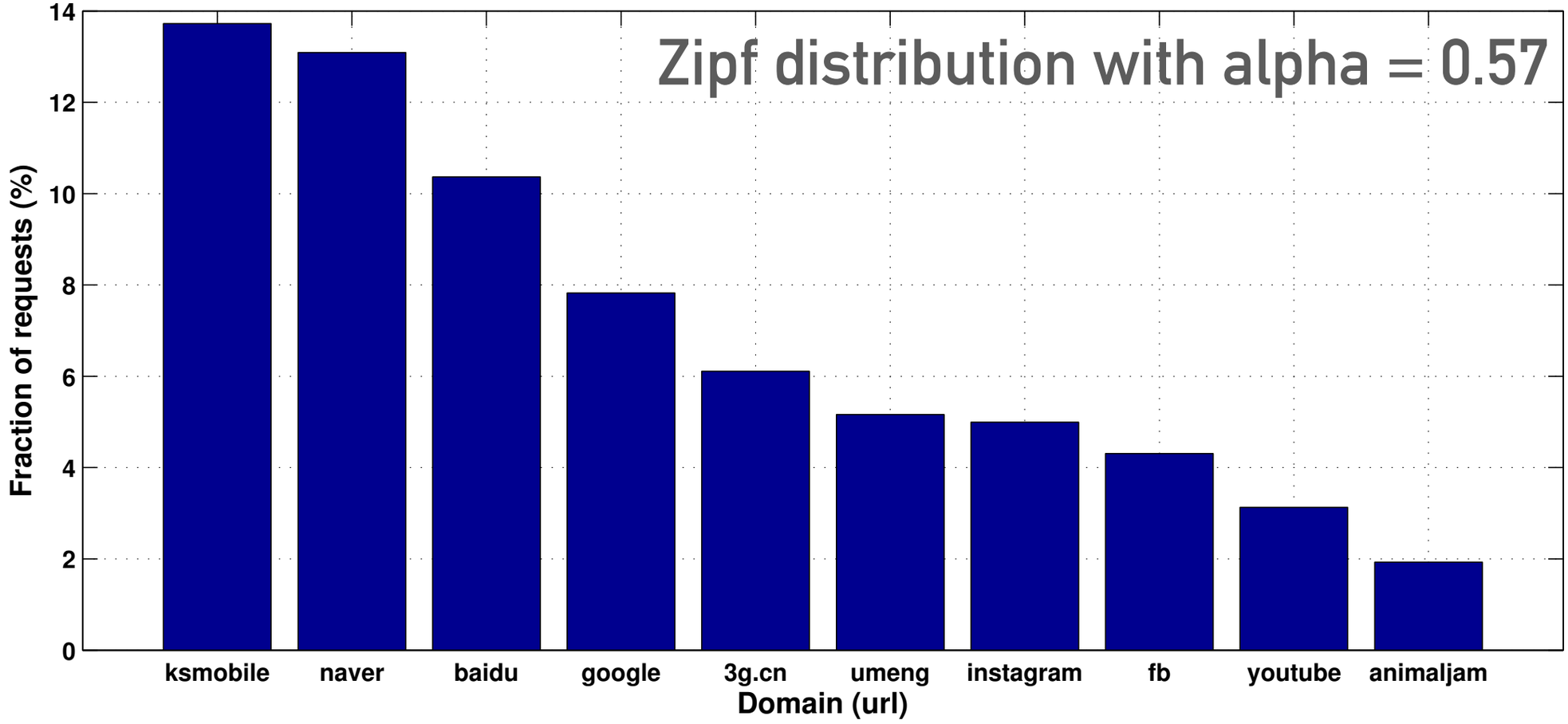
Dual off-peak hours

13:00 - 16:00

22:00 - 07:00

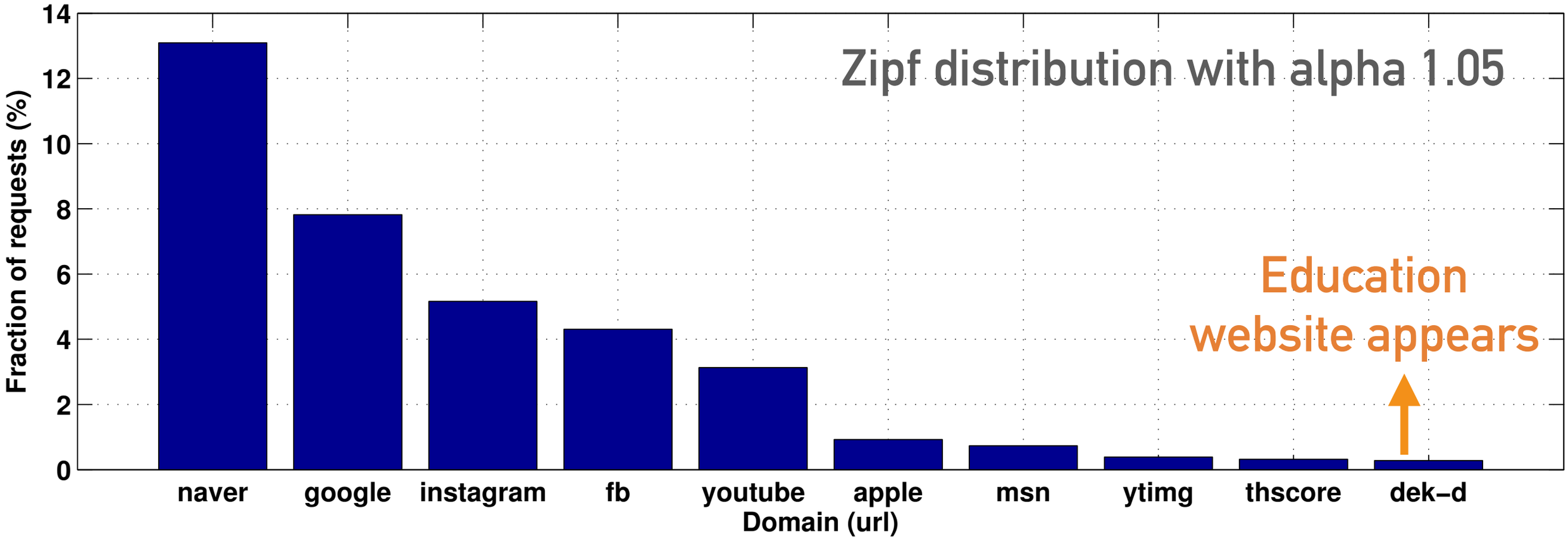
→ How can we efficiently utilise these resources?

CONTENT POPULARITY



- Commonly known alpha (0.9 - 1.1)
- Mixture of misbehaviour domains
- Some valuable domains such as education and local newspaper are pushed to the tail

CONTENT POPULARITY

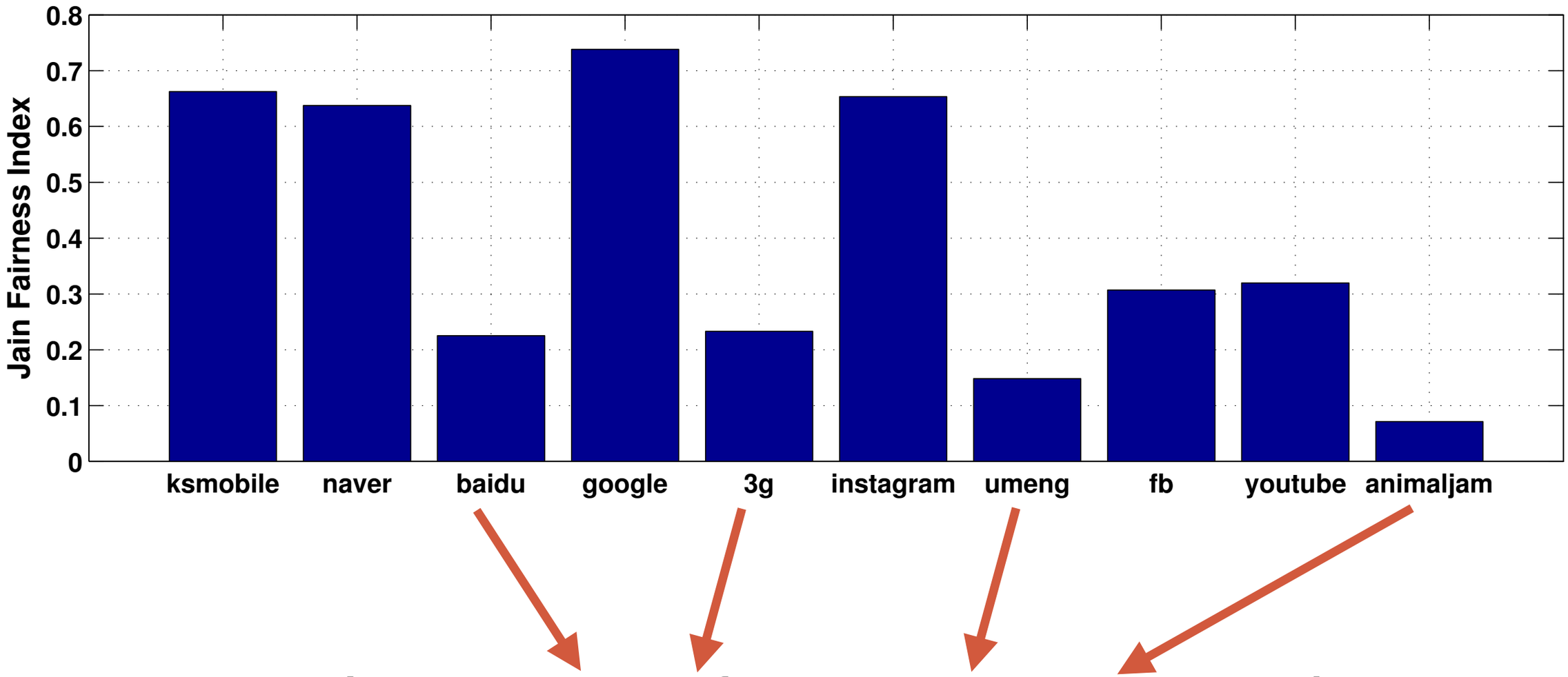


Remove all suspicious domains

ANALYSIS OF SUSPICIOUS DOMAINS

Jain's fairness index

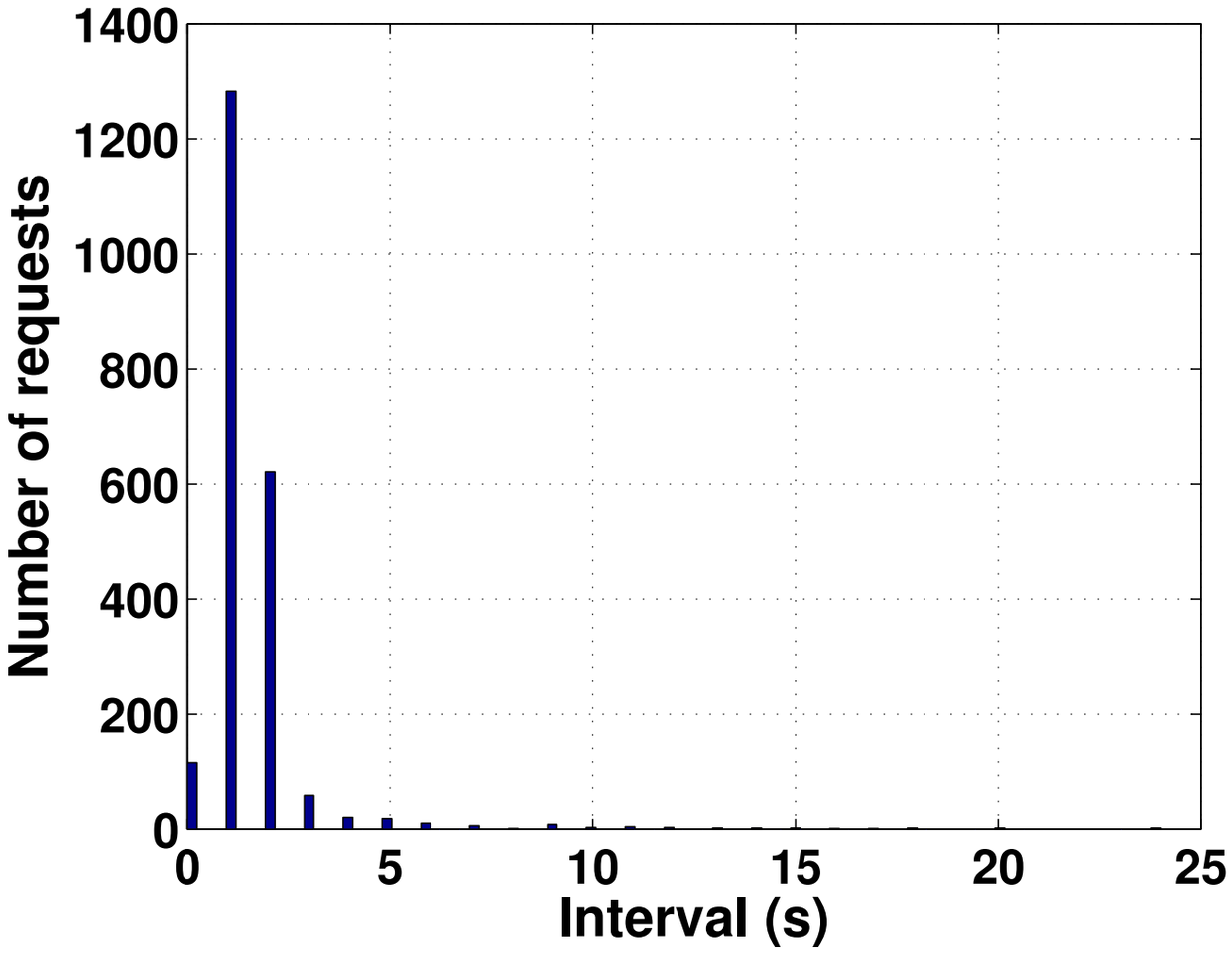
The higher value indicates the requests are more uniformly distributed



Large amount of requests were generated by some specific users

APPLICATION BEHAVIOUR

Inter arrival time of suspicious domain



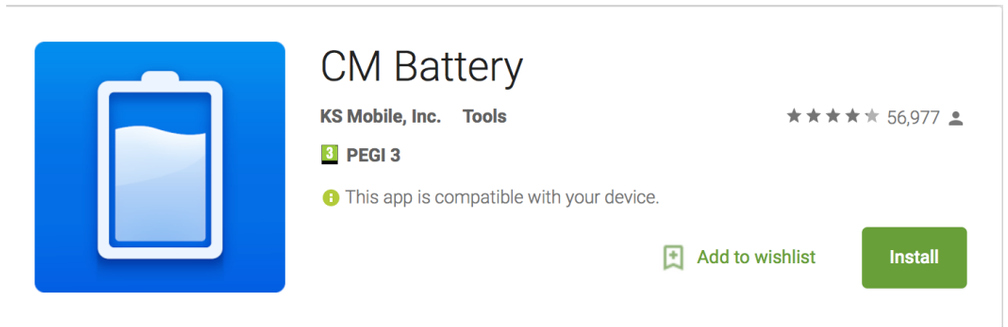
Almost 80% of requests are made with an inter arrival less than 2s

These requests were generated by the baidu browsers

baidu.com

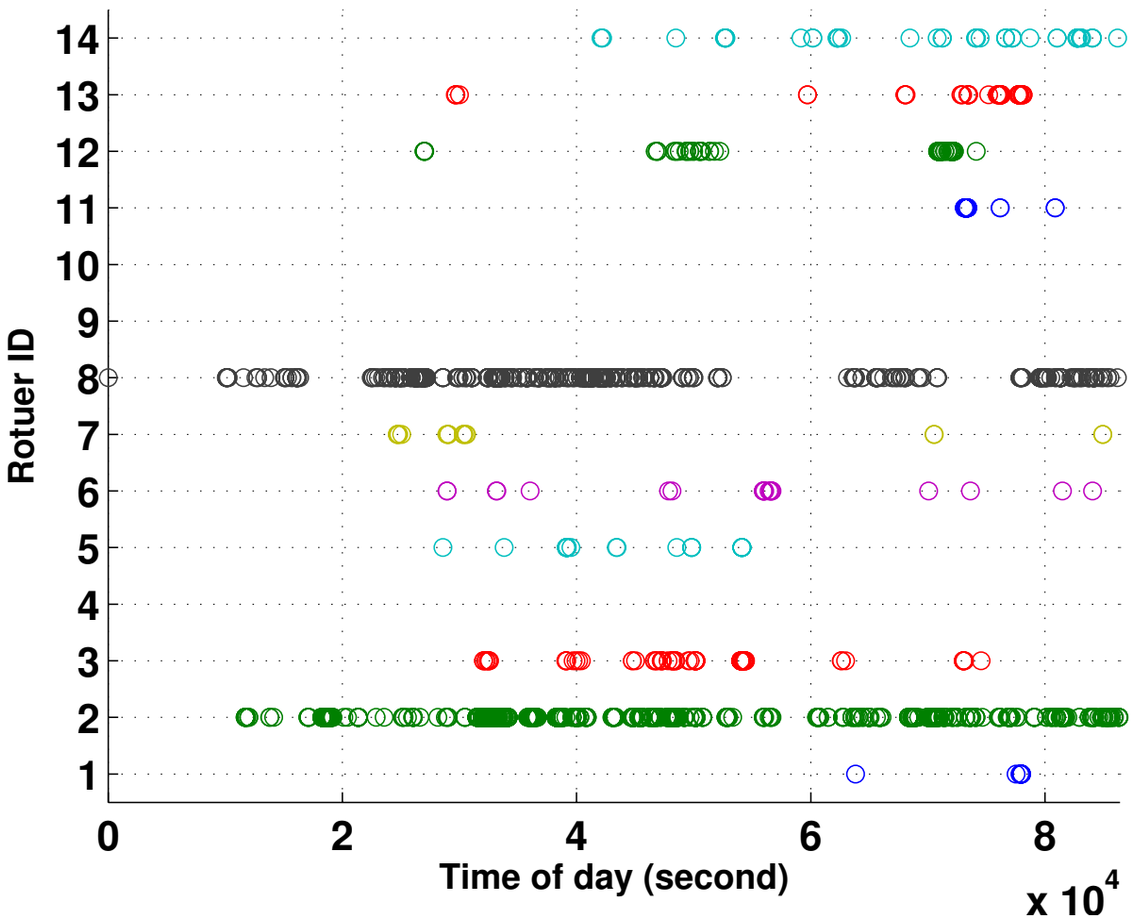
MISINFORMED KNOWLEDGE

- Several users misuse an application
- Considering ksmobile domain
  - Android application —> CM Battery
  - To save the battery power
  - But! the villagers believe that it can use to accelerate the WiFi speed
  - Fact! it generates a lot of request to ksmobile domain
  - Observation! advertisements are automatically downloaded to users' mobile phone
  - 85% of villagers use this application

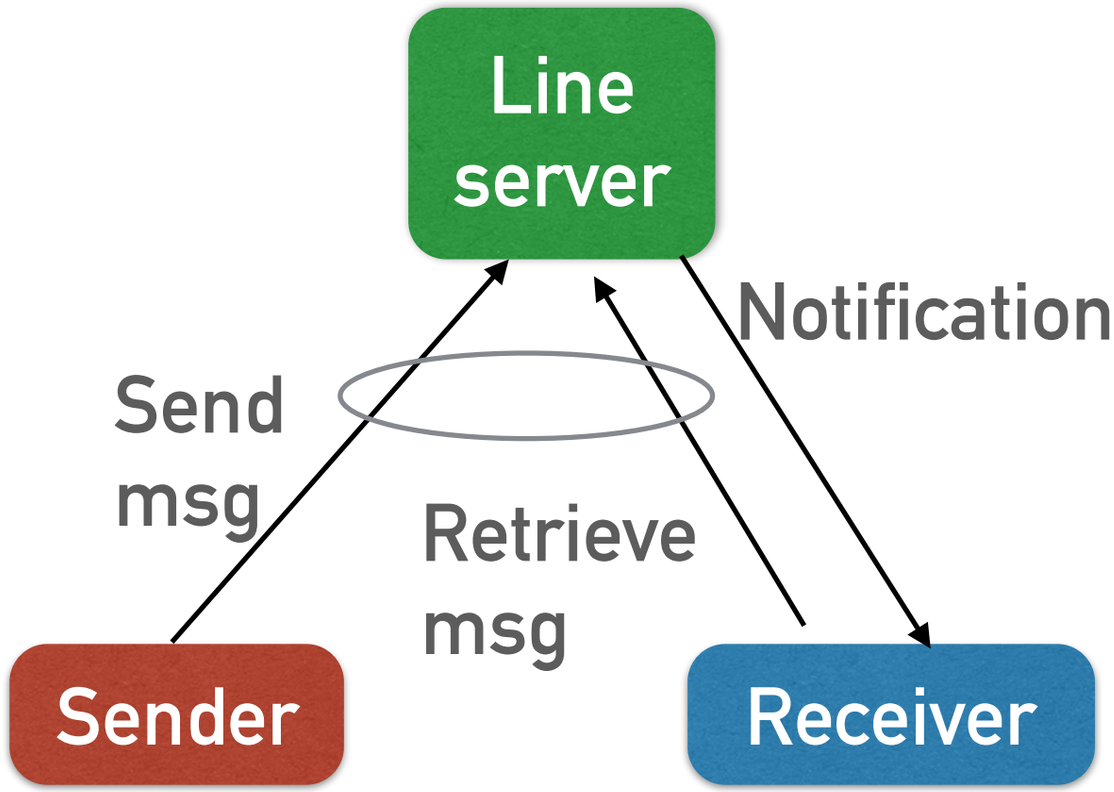


LOCALISED COMMUNICATION

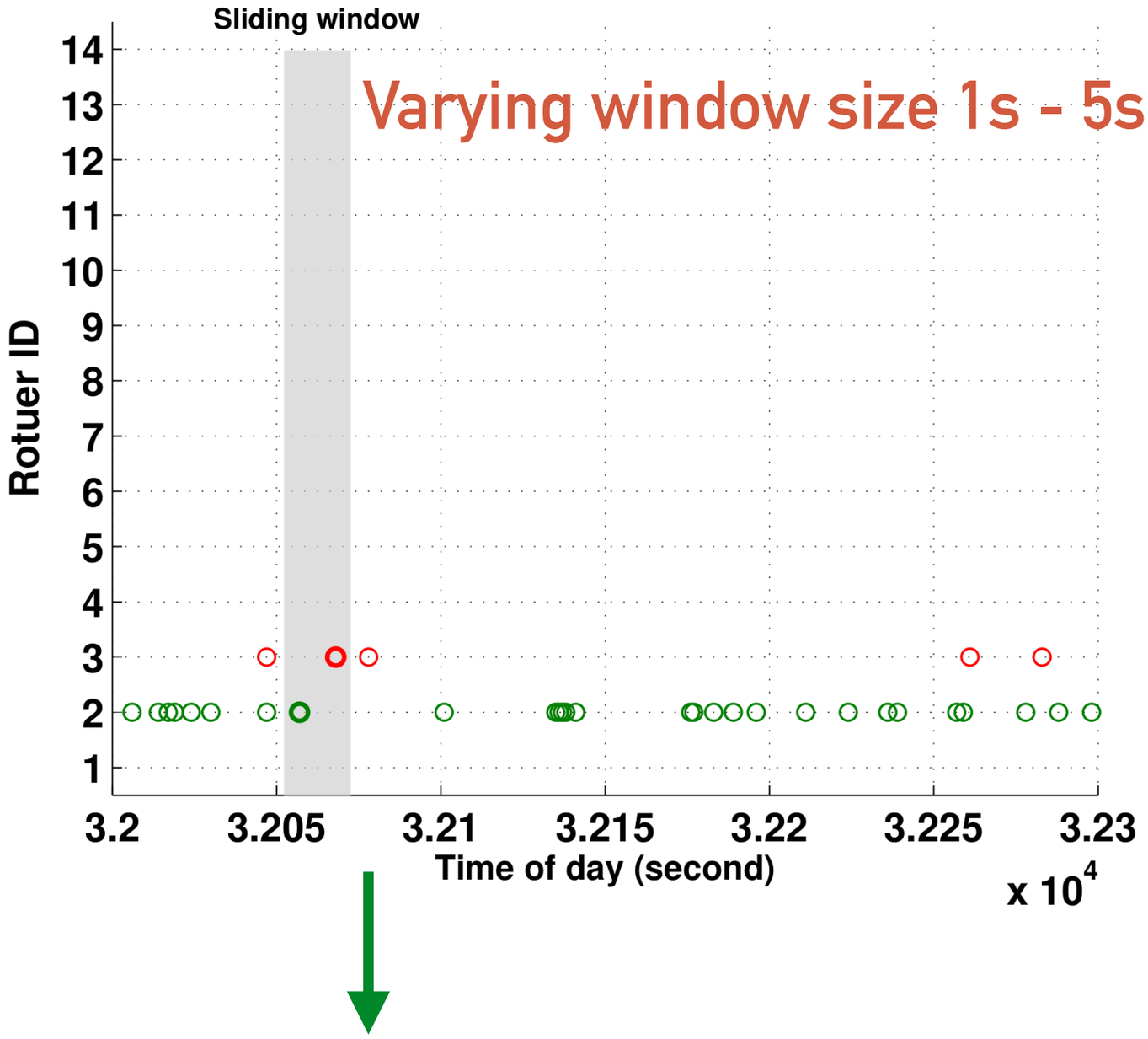
HTTP request to Line server from each router



Line application (naver)



LOCALISED COMMUNICATION



Achieve 10% - 15% of identified pairs

From interview, 10% - 20% were sent to the local contacts

A pair of communication represents the localised communication

TAKEAWAYS

What are the impacts of TakNet ?

- TakNet is able to create a demand within the community for Internet access
- Number of Internet users in TakNet is increased significantly
- Villagers gain significant benefits form the Internet
- TakNet is a catalyst for changes: ISPs expand more backhaul to cover the villages

TAKEAWAYS

Is there a universal model for all rural settings?

- Traffic pattern
  - Asia[1] - TakNet: Dual-peak pattern
  - Africa[2] and Europe[3]: Single peak:
- Localised communication
  - TakNet: 10 - 15%, Africa[2]: ~50%
- Social Communications
  - OSN (e.g., FB, Twitter) and email are popular services in rural Africa[2].
  - Instant messaging is the most dominant service in TakNet

[1] *B. Du, et al. Analysis of www traffic in cambodia and ghana. In WWW '06. ACM, 2006.*
[2] *D. L. Johnson, et al. Network traffic locality in a rural african village. In ICTD. ACM, 2012.*
[3] *A. Sathiaseelan, et al. A feasibility study of an in-the-wild experimental public access wifi network. In ACMDEV, 2014*

TAKEAWAYS

What are the potential solutions to improve TakNet?

- The available 4 Mbps bandwidth may be saturated soon in the near future.
- Can we simply expand the the link capacity or add more gateway?
  - Villagers are very sensitive to the cost
- Can we utilise the off-peak hours with content/service caching ?
  - Identify the true valuable contents
    - Efficiently remove the suspicious domains
  - New technologies
    - Information Centric Network
    - Service migration - virtualisation, container

THANK YOU
Q&A

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