

Introduction

Smartphones in 3G networks:

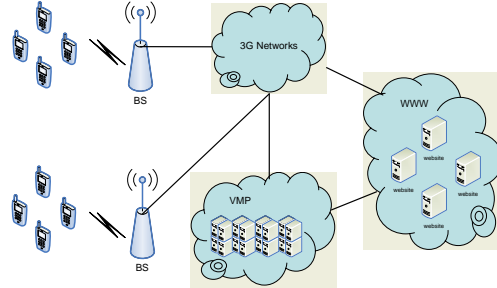
- Greater user access to the mobile Internet
- Many complex applications
- Consume more power

The key reason of the long delay and high power consumption in web browsing:

- The local computation limitation in 3G networks
- **NOT** the bandwidth limitation

Virtual-Machine based Proxy (VMP):

Shift the computing from smartphones to the VMP



The prototype:

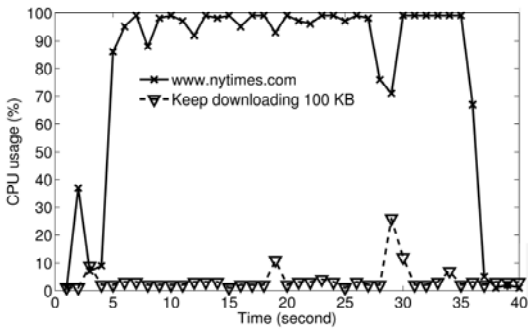
- Xen virtual machines
- Android Phones
- UMTS network

Experiment Result:

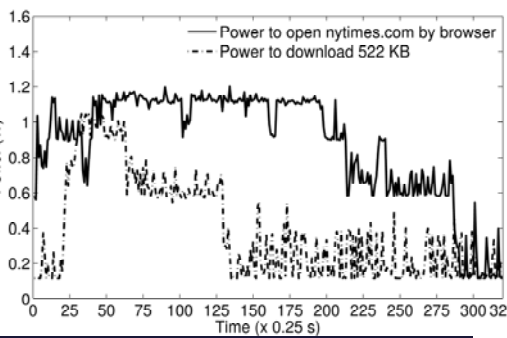
- Reduces the delay: 80%
- Reduces the power: 45%.

Motivation

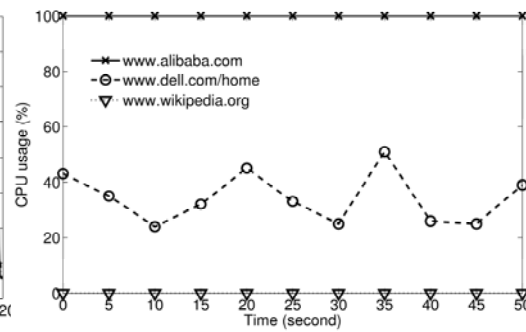
Long Delay Reason: Webpage become more complex and contain more objects.



Number of objects per Webpage:
2003: 25.7 2008: 49.9



More dynamic web content: javascripts and flash: CPU & Power

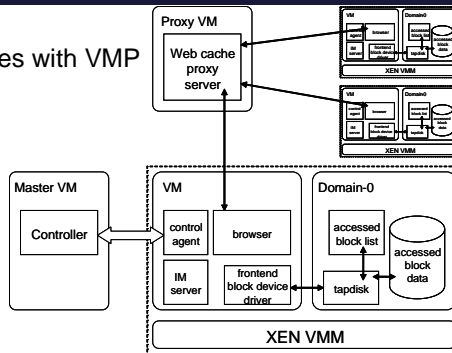


System

Interaction Model on smartphone communicates with VMP

Efficient Communication Mechanism

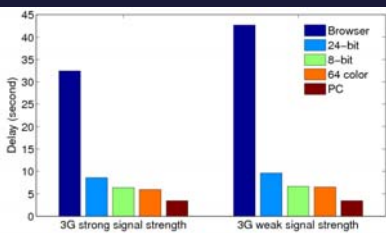
- Opening webpages
 - User operations after opening webpages
- VMP: Move the browsing service to the proxy
- VM Management:
Mast VM, Proxy VM, User VM



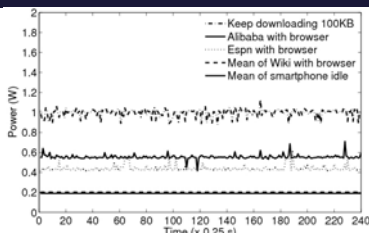
Measurement



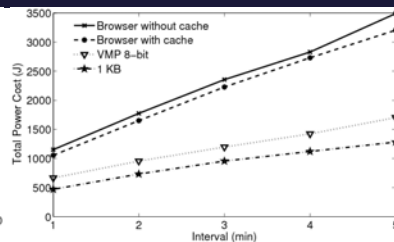
Performance



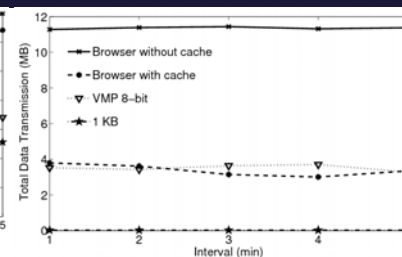
The average delay for opening benchmark webpages



Power consumption of typical webpages after being opened



Power consumption for opening benchmark webpages



Data transmission for opening benchmark webpages