

OPAL: Oppportunistic Alignment of Advertisement Delivery with Cellular Base station Overloads

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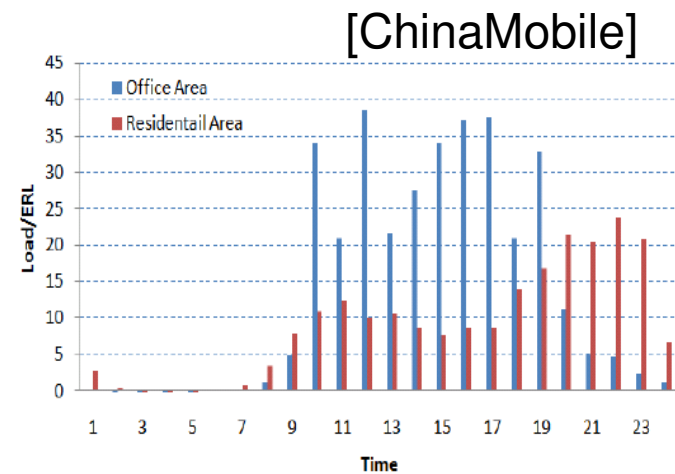
Motivation: 3 Observations

1. Mobile video traffic increasing significantly

- 66% Mobile content will be video by 2015 [Cisco]

2. Base station Overloads a growing concern

- Users QoE suffers, especially for video
- Not always overloaded: so worst-case provisioning expensive



3. Operator-enabled Mobile Advertising attractive revenue generator

- Users get interrupted every so often

OPAL aligns overloads with advertisements to minimize user interruption

What this paper “is”, and “is not”

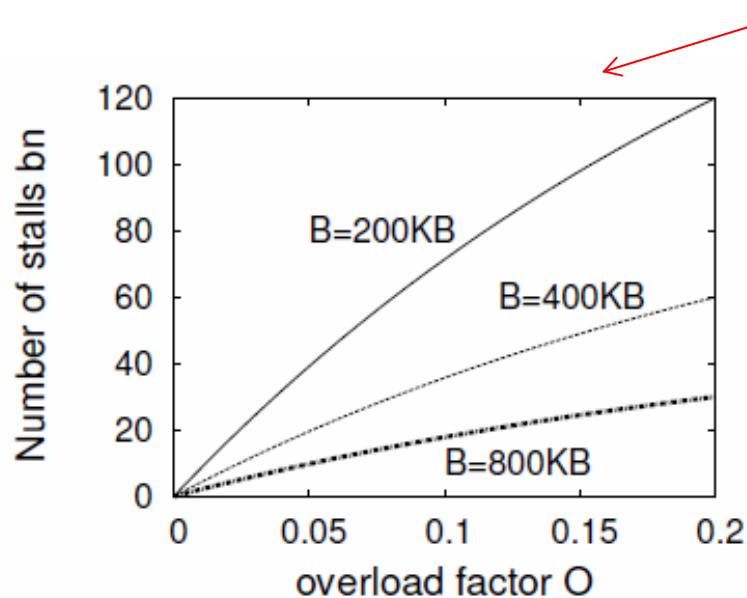
- This paper is not about advertising!
- Instead, it is the following:
 - Operator-enabled advertising will happen anyway
 - Basestation overloads are also happening anyway
 - How can we align them to improve the overall user perception of the cellular network?

Outline

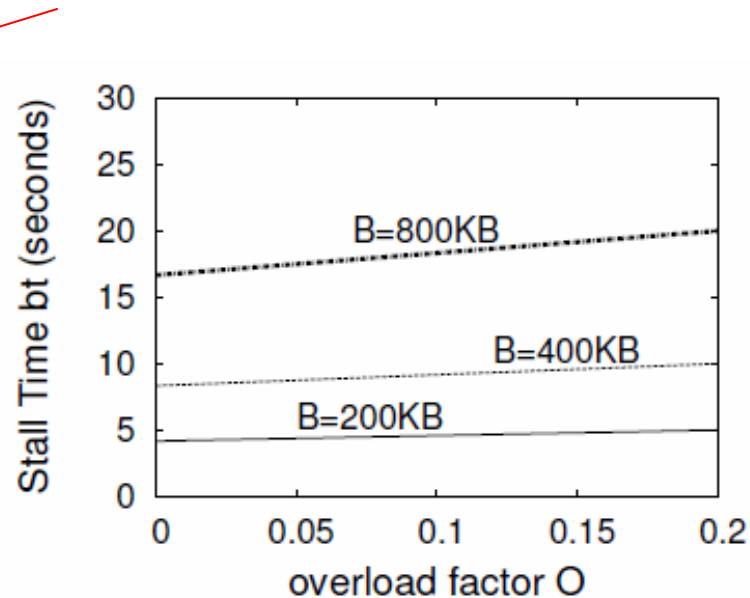
- Merits
 - Why align advertisement delivery with base station overloads?
- Opal Design Overview
 - How to do Overload Management to make it suit ad delivery?
 - How to do ad delivery?
- Evaluation
 - Prototype on a WiMAX testbed
 - Simulation with larger scale scenarios
- Conclusion
 - Future work

Impact of Base station Overload

- Base station overloads lead to reduced bandwidth per user
 - HTTP videos → number of stalls and time of stalls are important metrics [sigcomm11]
 - Tradeoff with client buffer size
 - More dramatic increase in num.stalls than stall time



(a) Number of stalls



(b) Stall time per instance

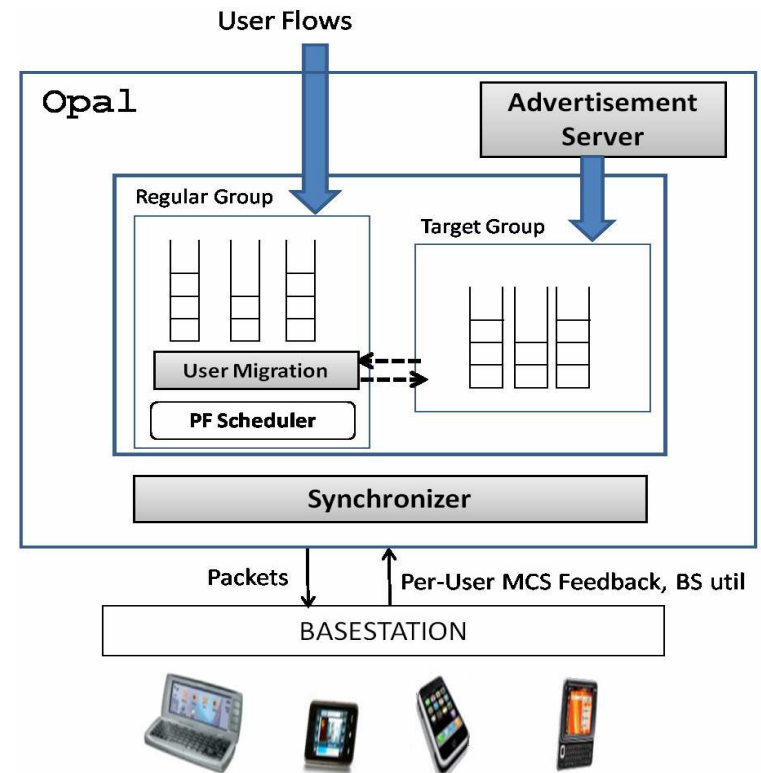
Can we do something using Ads?

- Advertisement delivery is in control of MNO
 - Choice of advertisements (banners to videos)
 - Rate of advertisements
- So, instead of letting every user suffer
 - show an advertisement of lower rate to some users
- Benefits both users and MNOs
 - Users: Notion of continuity of service, reduced pricing (ad-funded network service)
 - MNOs: Mask off the effect of overload, users happier than perceiving bad availability

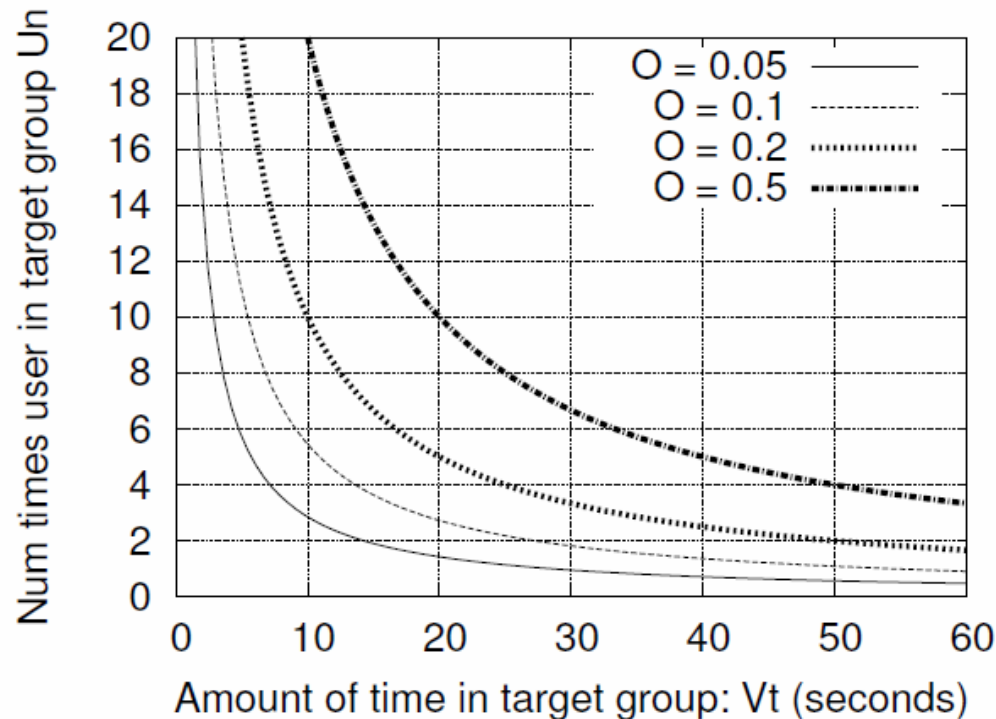
Opal Design

- When to migrate?
 - Uses Svc rate and queue buildup
 - Challenge: BS capacity unknown
 - Solution: Synchronizer
- Which users to migrate?
 - Uses a long term fairness metric
- When to bring the users back?

Gateway-level solution



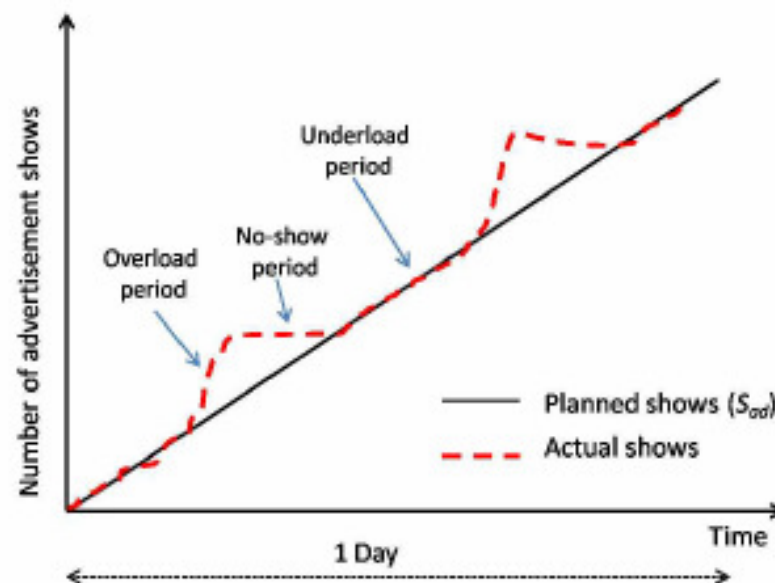
Tunable Unavailability Framework



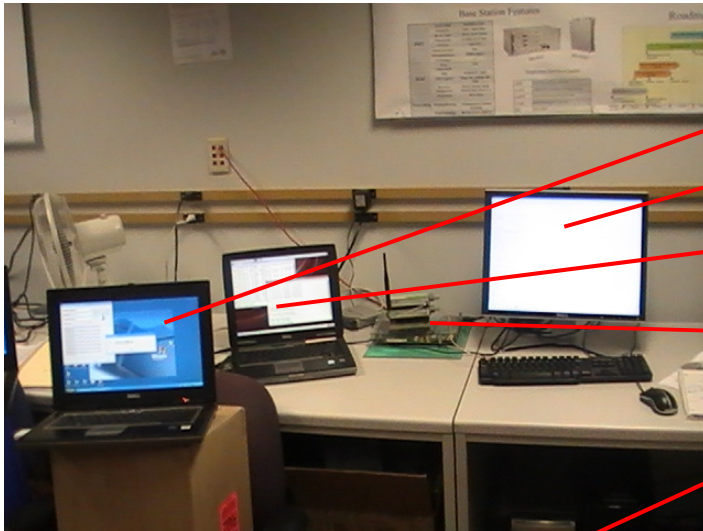
- V_t configurable by the network operators
 - Controllable \rightarrow predictable ad delivery
- Mobile Marketing Association suggests 15 to 30 seconds
 - www.mmaglobal.com
 - ~700 member companies

Advertisement Delivery

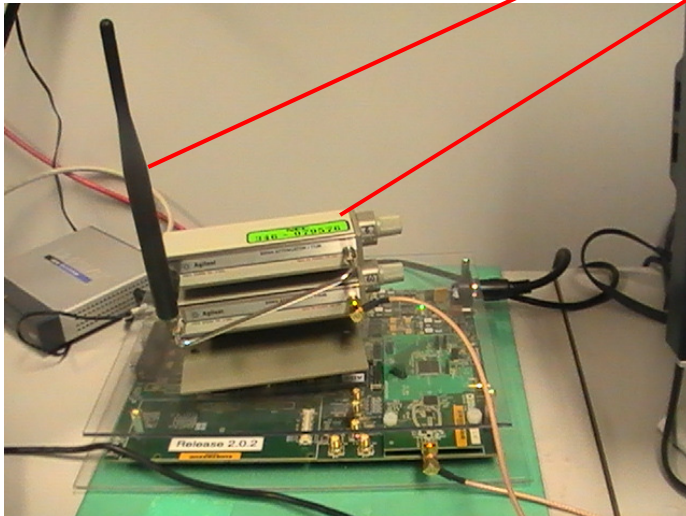
1. Show ads more aggressively during overloads
 2. Balance the total shows over a longer time period
 3. Current design: No state maintenance
 - The design changes slightly for targeted advertising
- Main challenge: Smooth inter-mixing of content and advertisements
 - Either intermediate proxy or
 - a notion of an ad channel that client side applications understand
 - Need standardization!



Prototype on a WiMAX Platform



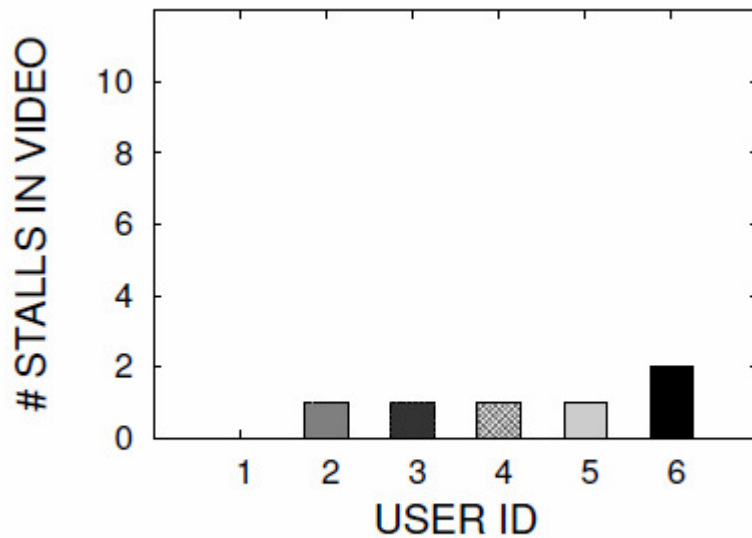
- Clients
- ASN Gateway
- CSN Gateway
- Basestation
- Antenna
- Attenuator



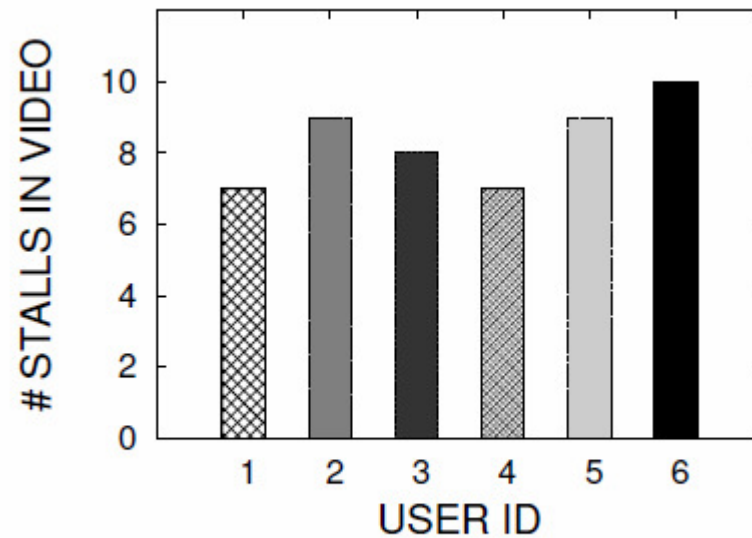
- Opal on ASN gateway
- Ad server attached to ASN gateway
- Client modified to play ad during buffer under-run
- Feedback from BS every 100ms

Expt 1: QoE Improvement

Prototype setup: YouTube videos are streamed to six clients.



OPAL



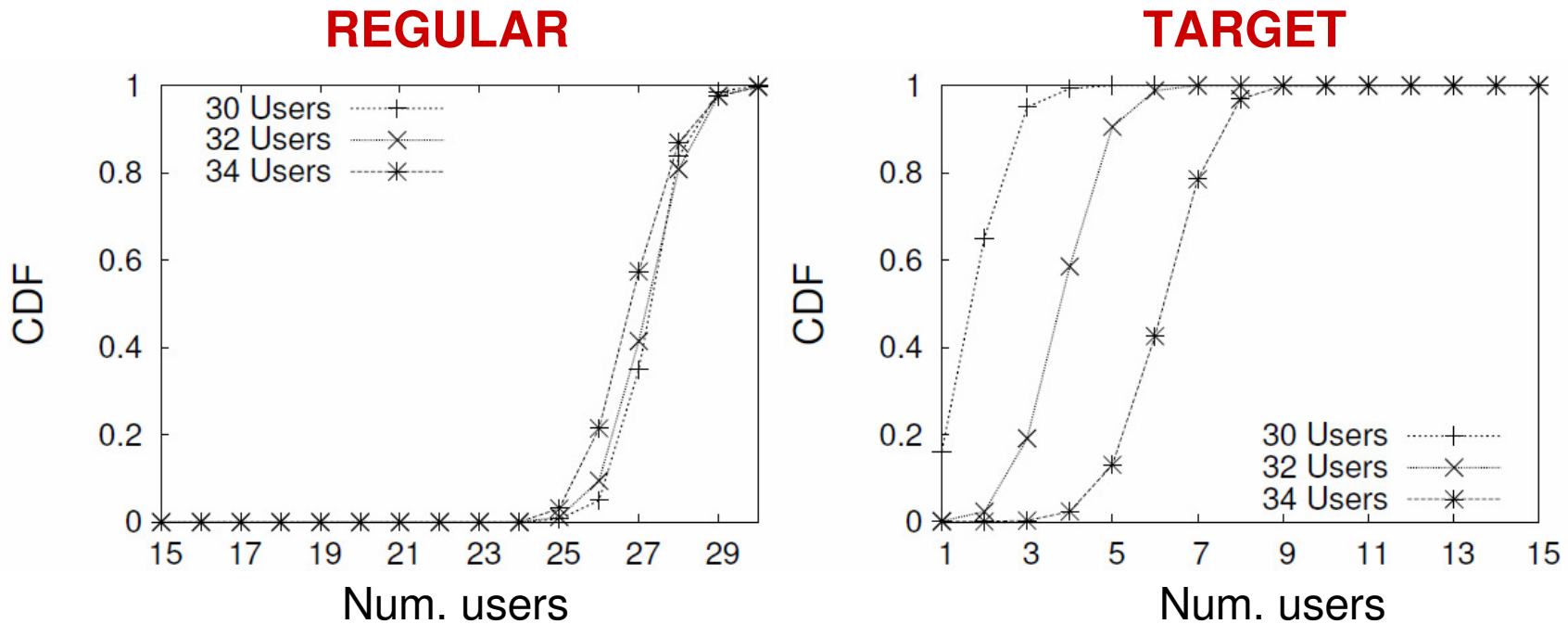
NO-OPAL

1. Serving Ads to a few users ensures maximum users see good quality.
2. OPAL efficiently uses advertisements to hide service disruption.

Expt 2: Simulation Study

Set-up: In-house System-level OFDMA simulator with representative traffic models and channel models.

Videos are streamed to 30,32 and 34 users



OPAL finds the appropriate no. of users in the regular slice

Conclusion

- OPAL: Align advertisement delivery with cellular basestation overloads
 - Improves overall user perception of network availability
- Operator Enabled Advertising: Lot of Scope for Future Work
 - Incorporate different classes of users
 - Targeted and location-based advertising
 - Multicast for advertisements, or local playout on user devices
 - Quantify user perception of overloads and Advertisement delivery
 - ...

Backup

Network Operators' Challenge

China Mobile http://labs.chinamobile.com/article_download.php?id=63069

Telefonica: <http://research.microsoft.com/en-us/events/cnb2010/pablorodriguez.pdf>

Sprint: <http://www.slideshare.net/trxrse/traffic-revenues-decoupling-3584286>

→ Increasing Cost to support ever growing traffic

- Traffic increasing by 90% every year
- Network throughput increasing by 55%

→ Reducing Revenue per byte due to data traffic

