Revisiting Network Energy Efficiency of Mobile Apps: Performance in the Wild

Sanae Rosen[1] Ashkan Nikravesh[1] Yihua Guo[1] Z. Morley Mao[1]
Feng Qian[2] Subhabrata Sen[3]

[1]University of Michigan

[2]Indiana University

[3]AT&T Labs – Research

The Problem

- Over the past 15 years, CPU performance has increased 250x but battery life has only doubled!
- We know how to design apps that dont drain batteries (as much)...

SCIENTIFIC AMERICAN™

Sign In | Register 0

Search ScientificAmerican.com

Subscribe | News & Features | Topics | Blogs | Videos & Podcasts | Education | Citizen Scien

Tech » Features :: Email :: Print

This article is from the In-Depth Report Consumer Electronics in 2015: Building the Internet of Things

People Love Their Smartphones but Hate the Batteries [Survey Results]

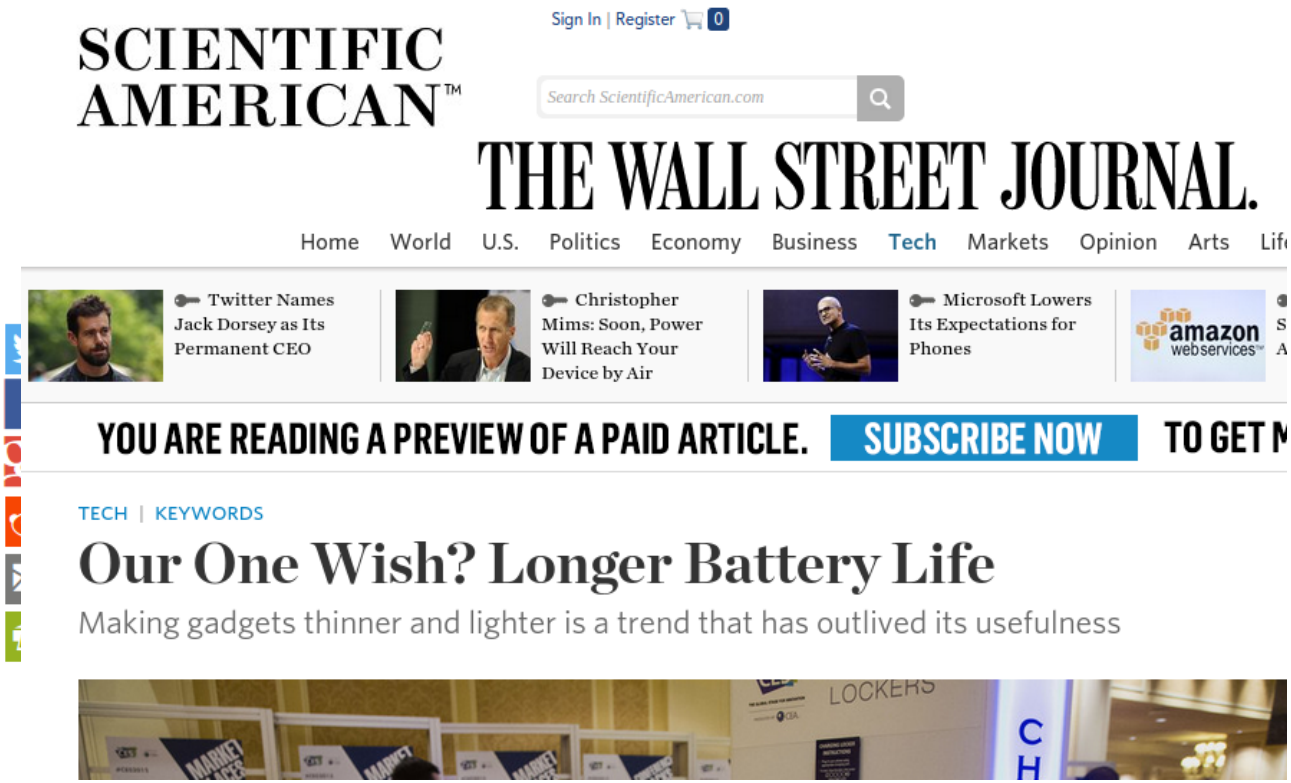
Scientific American readers say smartphones have not replaced tablets or PCs, and still need better batteries, cameras and biometric security options

By Larry Greenemeier | November 28, 2014

More than 2,000 *Scientific American* readers responded to last month's online survey asking how they use their smartphone, which gadgets it

The Problem

- Over the past 15 years, CPU performance has increased 250x but battery life has only doubled!
- We know how to design apps that dont drain batteries (as much)...

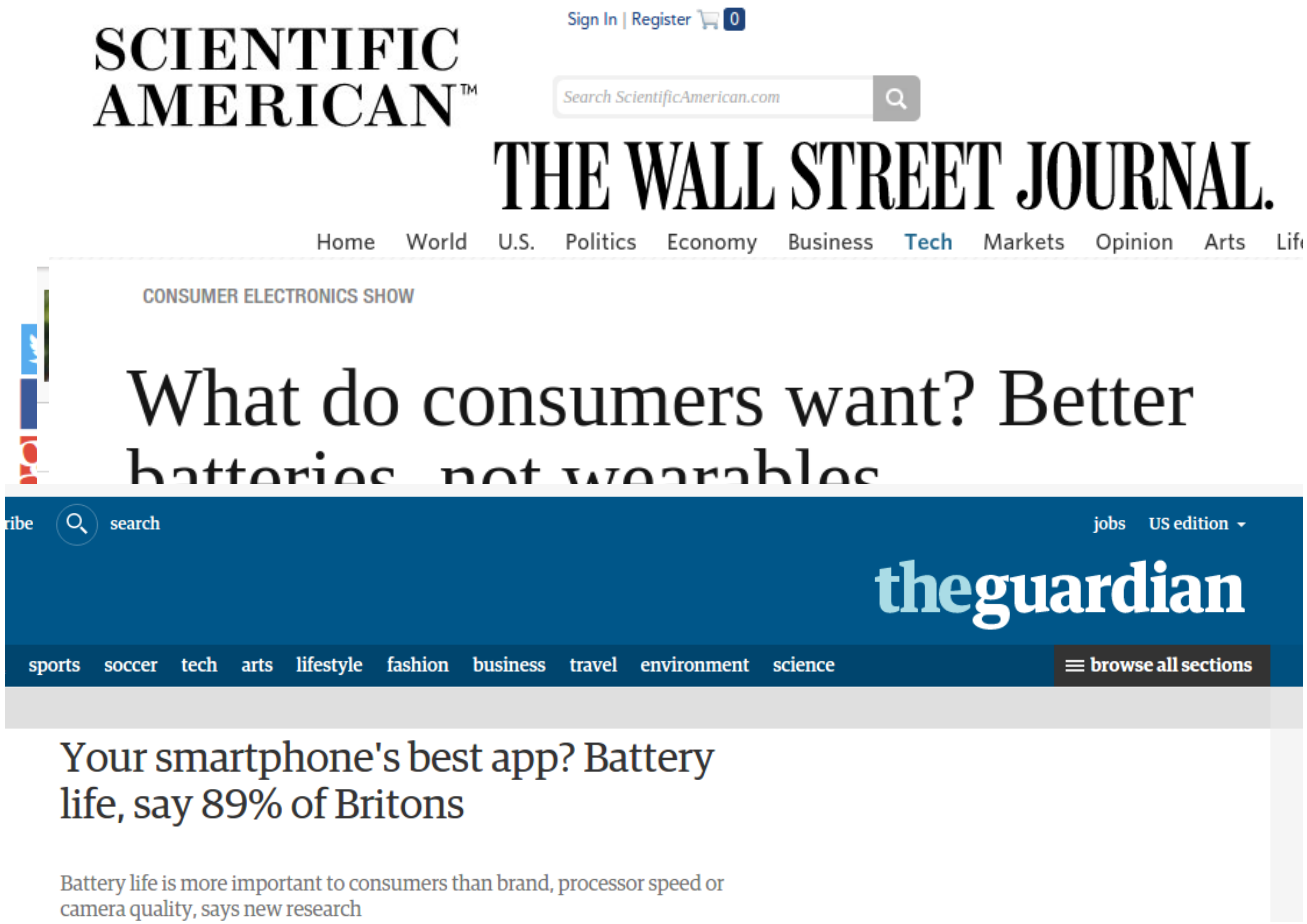


The Problem

- Over the past 15 years, CPU performance has increased 250x but battery life has only doubled!
- We know how to design apps that dont drain batteries (as much)...

The Problem

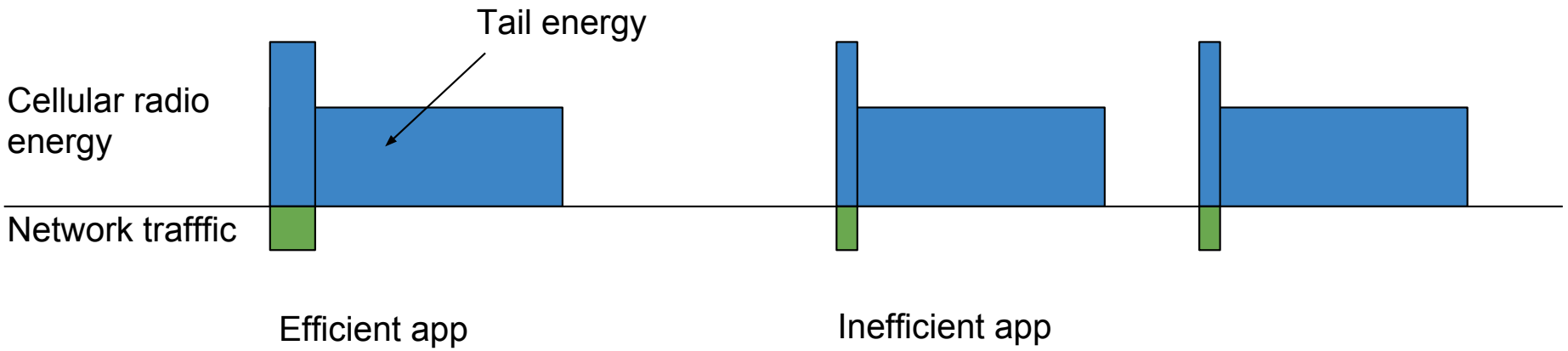
- Over the past 15 years, CPU performance has increased 250x but battery life has only doubled!
- We know how to design apps that dont drain batteries (as much)...



Prior work: App design is a problem

Application network patterns make a huge difference, generally

- Periodic transfers have a disprportionate impact[1]
- Understanding app behavior in the wild is essential[2]
- Continuous online presence has a high cost[3]



[1] Huang et al, MobiSys 2012; Qian et al, WWW 2012
[2] Xu et al, IMC 2011; Gember et al, IMC 2012
[3] Aucinas et al, CoNEXT 2013

Research questions

- What are real users experiencing in the wild?
- Given all this interest, are apps getting better?
  - Some are, but many apps aren't.
  - Background updates are often too frequent for how much users use the app.
  - New problem: foreground traffic that keeps running after the app is closed.
- Are current measures sufficient?
  - Per-app ad-hoc performance improvements don't solve the problem entirely
  - We show minor OS-level suppression of background traffic from underused apps can make a big difference

Overview

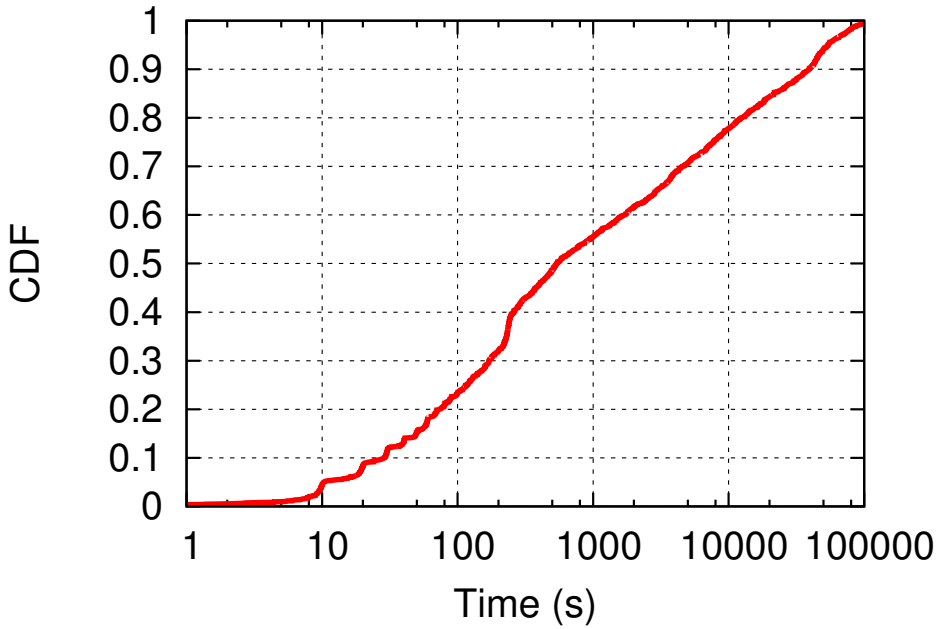
- Experimental setup
- Contribution 1: Foreground traffic not terminated
- Contribution 2: Background traffic continues to drain battery.
- Contribution 3: Excessive background traffic from unused or underused apps.
- Recommendations

Methodology

- 20 users, 342 apps total, over almost 2 years
- Collect unencrypted packet payloads, user input events, packet-process mappings, foreground/background process codes
- All data anonymized, study IRB-approved
- Highly diverse set of top apps among users, but some in common (e.g. facebook)

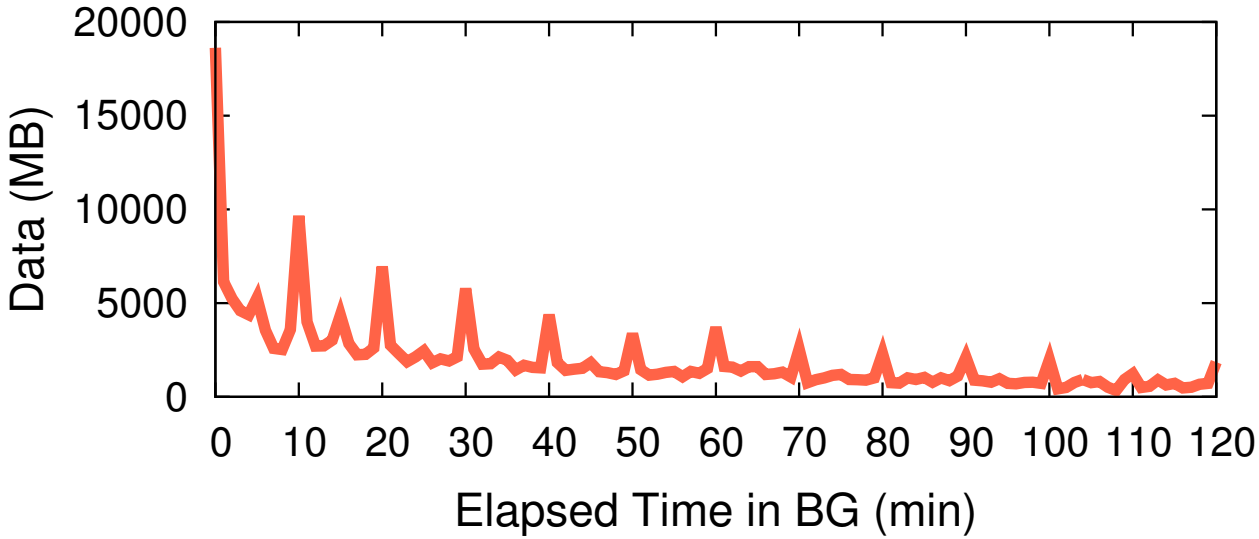
Foreground requests not terminated

- Majority of Chromes traffic occurs in the background!
- Root cause: requests started in the foreground keep running
- A popular local website sends network requests every 2 seconds
  - Can continue for hours, even after the app is minimized



Duration traffic sent/received after Chrome sent to background.

Foreground requests not terminated



84% of apps send 80% of background traffic within 60s of minimizing the app

Periodic background traffic

For many apps described in prior work, this has gotten a lot better. For example[4]:

App	Beginning	End
Pandora, Facebook	every 1 minute in 2012[5]	1/ hour
Gmail	Every 30 minutes	Highly varying intervals, as needed?
Go Weather	5 minutes	40 minutes

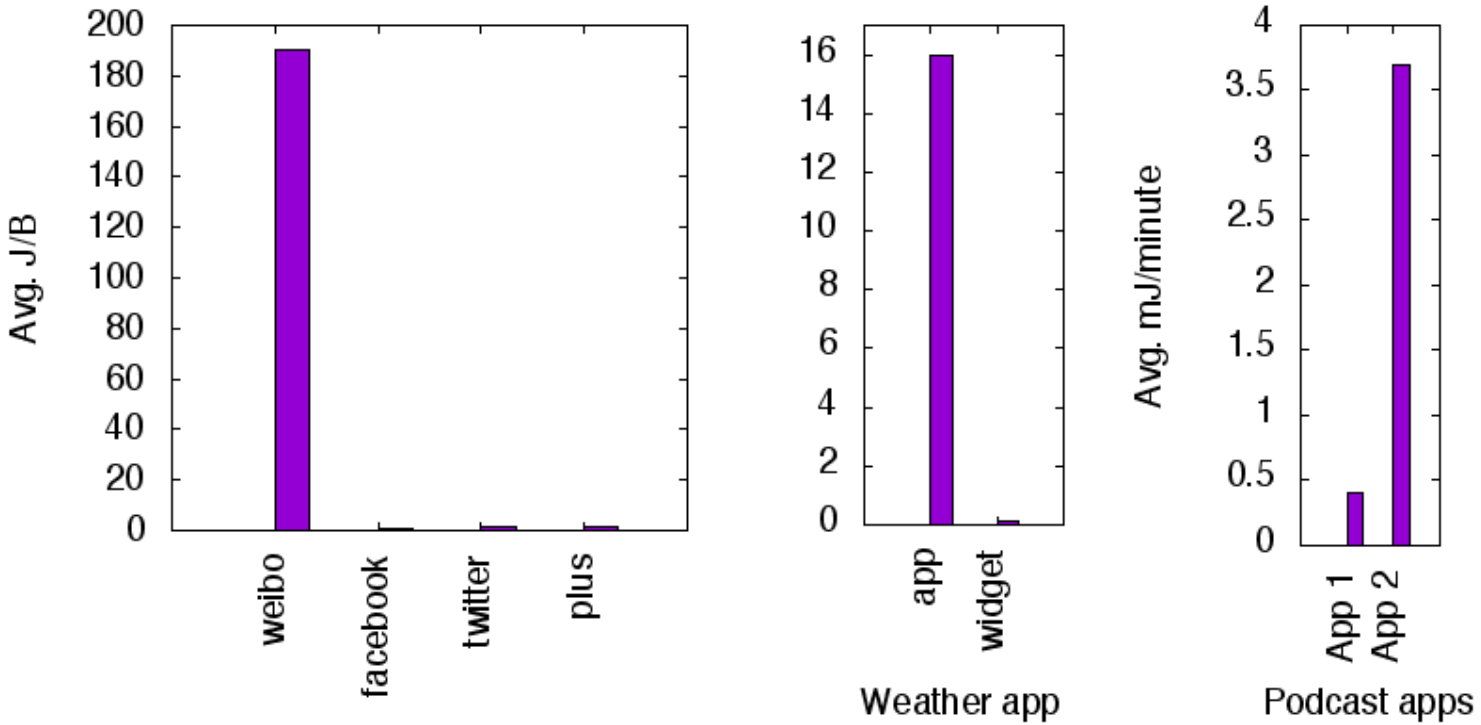
Update frequencies

Is the problem solved?

[4] See the paper for more details

[5] Qian et al, WWW '12

Periodic background traffic



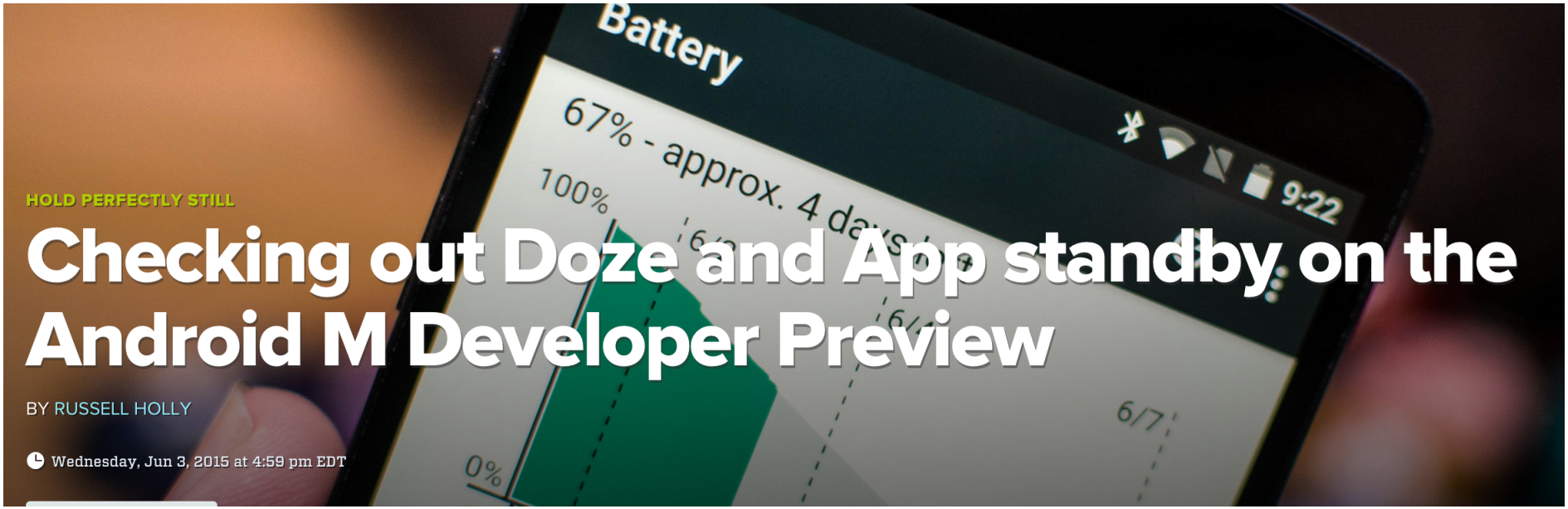
Getting it consistently right, every time, probably won‘t happen

Unused background traffic

- We observed background traffic is sometimes present even for apps a user rarely uses
- What if we try something really simple like killing an app after its unused for 3 consecutive days?

	Plus	Weibo	Maps	ESPN	Accuweather	Skype
A: % days with only background traffic	42	83	70	13	43	62
B: Max consecutive background days	40	24	84	10	18	49
C: Disable after 3 days: avg.% energy reduction	14	54	39	6.2	22	45

Unused background traffic



After our paper was submitted, Google announces OS support for managing background traffic and reducing power consumption...

Conclusions and recommendations:

- Apps should be aware of their foreground/background state and be sure to manage network traffic appropriately
- Major apps reducing periodicity of network traffic + using improved push services has been helpful
  - Now to get everyone else on board!
- OS-level management of background traffic would be very valuable
  - There are millions of apps, we cant expect every developer to get it right

Thank you!

Any questions?