MicroCast: Cooperative Video Streaming on Smartphones

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Outline

- Introduction
- The MicroCast System
- Performance Evaluation
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The “Micro” Setting
“Micro” Setting is a Common Use Case

1 in 5 male 18-34 view YouTube on Mobile daily

50 % of M18 – 34 look at videos with friends in person

Source: Google
Current Approach: Multiple Downloads
MicroCast: Jointly Use Multiple Interfaces
Related Work

- Cooperative Mobile/Wireless Systems
  - Social based forwarding [Hui08], [Ioannidis09]
  - Joint download [Ananthanarayan07]
  - Multihomed devices [Rodriguez04], [Chesterfield05]
  - Connection to multiple AP [Soroush11]
  - Wi-Fi offloading [Subramanian12]
  - ...

- Network Coding in Cooperative/Wireless Systems
  - Multiple unicasts [Katti08]
  - Broadcast [Sen10]
  - Baochun Li’s group @ UToronto
  - F. Fitzek’s group @ Aalborg
  - ...

- Network Coding P2P Systems
  - Avalanche [Gkantsidis05]
  - R2 [Wang07]
  - UUSee [Liu10]
  - ...
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MicroCast Architecture
MicroDownload: Download Coordination

- **GUI**
- **Storage**
- **MicroDownload**
- **MicroNC-P2**
- **MicroBroadcast**
- **Cellular**
- **WiFi/Bluetooth**
How MicroDownload Works

Video stream

Segment
Segment
Segment
Segment
Segment
Segment
Segment

# proportional to download rate

MicroDownload

Scheduler
MicroNC-P2: P2P Optimized for the “Micro” Setting
Local Wireless Capacity is Limited
Efficient Transfer Using Broadcast
Efficient Broadcast Using Network Coding
MicroNC-P2 Protocol

Phone 1

Phone 2

Phone 3

One coded packet for every original packet

overheard coded packets

notify request

Segment rcvd from cellular

overheard coded packets

notify request

max number of coded packets requested

overheard coded packets
MicroBroadcast: High Rate Broadcast
Mobile WiFi Hotspot

Access point
Broadcast in 802.11 infrastructure mode
Pseudo-Adhoc with MicroBroadcast

Access point

MicroBroadcast

Overhearing

Unicast packet

MicroBroadcast

MicroBroadcast

MicroBroadcast
Implementation on Android

Samsung Nexus S

Android 2.3
Outline

- Introduction
- The MicroCast System
- Performance Evaluation
  - Benefits of Collaborative Download
  - Benefits of MicroNC-P2
  - Energy Cost
Download Rate in Non-Congested Local Area

- **MicroCast (MicroNC-P2)**
- **MicroCast (BitTorrent)**
- **No-Cooperation**

Only 4 devices connected to 3G
Local Traffic Generated by P2P Modules

![Graph showing local traffic generated by P2P modules as a function of the number of phones. The graph compares two P2P modules: MicroCast (MicroNC-P2) and MicroCast (BitTorrent). The amount of local traffic is measured in MB.]
Download Rate in a Congested Local Area

Only 4 devices connected to 3G

![Graph showing download rates with different number of connected phones]

- MicroCast (MicroNC-P2)
- MicroCast (BitTorrent)
- No-Cooperation

Average download rate [Mbps]

Number of phones

L. Keller et al.
(EPFL, UCI)
MicroCast: Cooperative Video Streaming on Smartphones
Energy Consumption

![Graph showing energy consumption over time for different protocols. The x-axis represents time in minutes, and the y-axis represents remaining battery percentage. The graph compares No-Cooperation, MicroCast STA (MicroNC-P2), MicroCast AP (MicroNC-P2), MicroCast STA (BitTorrent), and MicroCast AP (BitTorrent).]
Conclusion

- **MicroCast**: collaborative video streaming on smartphones
  - **MicroDownload**: collaborative use of downlinks
  - **MicroNC-P2**: all-to-all dissemination protocol, customized for the “micro” setting to exploit broadcast+network coding
  - **MicroBroadcast**: high rate WiFi broadcast
Thank you!

More available at

microcast.calit2.uci.edu

Demo tonight at 18h

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Local Traffic: MicroNC-P2 vs BitTorrent vs R2

![Bar Chart]

- **R2-Push**
  - Star Topology
  - Clique Topology

- **BitTorrent-Pull**
  - Star Topology
  - Clique Topology

- **MicroNC-P2**
  - Star Topology
  - Clique Topology

Local traffic generated by the distributors [MB]
Network coding implementation performance

![Graph showing network coding implementation performance](image)
Theoretical model

![Graph showing theoretical model](image)