MicroCast: Cooperative Video Streaming on Smartphones

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Streaming on Mobile Devices

• Increasing use of smartphones to stream videos

• This leads to demand bottlenecks at cellular base stations
  • 23% of base stations have utilization rate of > 80%

• Service loss rate of up to 50%
• Problem: multiple users want to watch *same* video, at the *same* time, in the *same* place, on *different* devices

• Solution: MicroCast!
  • ...MicroDownload, MicroNC-P2, MicroBroadcast
Architecture

MicroCast
Architecture - MicroDownload

• Runs on a single phone

• Handles scheduling

• Recovery from failures?
• Pseudo-broadcast: combination of unicast and overhearing (implemented in MicroBroadcast)

• The algorithm disseminates *random linear combinations* of packets within a segment

• More efficient than BitTorrent or R2 in this setting
Architecture - MicroNC-P2

Phone 1

Phone 2

Phone 3

all dimensions of segment

notify

request

segment received from cellular

notify

request

overheard dimensions

overheard dimensions

max dimensions of request
Architecture – MicroBroadcast

• Choice of network interface – WiFi/3G/Bluetooth

• Recall: pseudo-broadcast = combination of unicast and over-hearing

• Pseudo-adhoc mode
  • Allows over-hearing without unnecessary traffic
Evaluation – MicroDownload

![Graph showing download rate over time for different phones](image)

- **Download Rate (Kbps)**
- **Time (second)**

- **Phone 1**: Red squares
- **Phone 2**: Green triangles
- **Phone 3**: Purple asterisks
Evaluation – MicroDownload

• 750kB file download, split across three phones
  • Static: DL time ~80sec.
  • Adaptive (with MicroDownload): DL time ~10sec.

• Adaptive request mechanism reduces bottlenecks at slower phones
Evaluation – Competitors – BitTorrent

Phone 1

Phone 2

Segment received from cellular

Phone 3

have

request

piece(segment)

have

request

piece(segment)
Evaluation – Competitors – R2

Phone 1

D x (1 + \Delta) dimensions

segment decoded

Phone 2

D dimensions received from cellular

D x (1 + \Delta) dimensions

brake

Phone 3

segment decoded
Evaluation – MicroNC-P2

![Graph showing local traffic introduced by different methods in star and clique topologies.](image)

- **R2-Push**: Lower local traffic in (a) Star Topology and higher in (b) Clique Topology.
- **Bittorent-Pull**: Moderate local traffic in both topologies.
- **MicroNC-P2**: Highest local traffic in (a) Star Topology and moderate in (b) Clique Topology.

*Local Traffic Introduced by the Distributors (MB)*
Evaluation – MicroNC-P2

Star Topology

Clique Topology
Evaluation – MicroCast

![Graph showing average download rate (Kbps) vs. number of phones for 20 Mbps and 4 Mbps connections.]

- **20 Mbps**
- **4 Mbps**
Evaluation – Battery Life

The graph shows the battery life over time for different conditions.

- **No-Cooperation**
- **MicroNC-2P Normal**
- **MicroNC-2P Access Point**
- **BitTorrent-Pull Normal**
- **BitTorrent-Pull Access Point**
Discussion

• Are there actual, useful applications for MicroCast?
  • Use cases seem very restricted (same video, same time, same place, ...)

• How does MicroCast deal with failures?
  • Offline failures, malicious nodes, ...
Discussion (cont’d)

• Scheduling algorithm (MicroDownload) is simplistic, to say the least

• Components are supposedly modular, but are they useful on their own?

• Is MicroCast scalable?