Cedos: a Practical Cellular Data Offloading System for Mobile Users

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Wi-Fi Offloading

- Detouring cellular data to high-bandwidth, low-cost Wi-Fi networks

- Wi-Fi APs are actively deployed by ISPs

- Delay helps increasing Wi-Fi contact chances
  (Wi-Fi offloading ratio: 60% → 93.7% with 1 hour delay[1])

[1] K. Lee, I. Rhee, J. Lee, S. Chong, and Y. Yi. Mobile Data Offloading: How Much Can WiFi Deliver? (CoNEXT '10)

Problem with on-the-spot Wi-Fi offloading

1. Change of IP address when switching Wi-Fi ↔ LTE
   - Causes all on-going TCP connections to fail
   - Requires retransmission of the same content

2. No practical system supporting **delayed** offloading
   - Exploits Wi-Fi contacts with deadline guarantee
   - Allows long disconnection and supports transport-level resumption

System Design
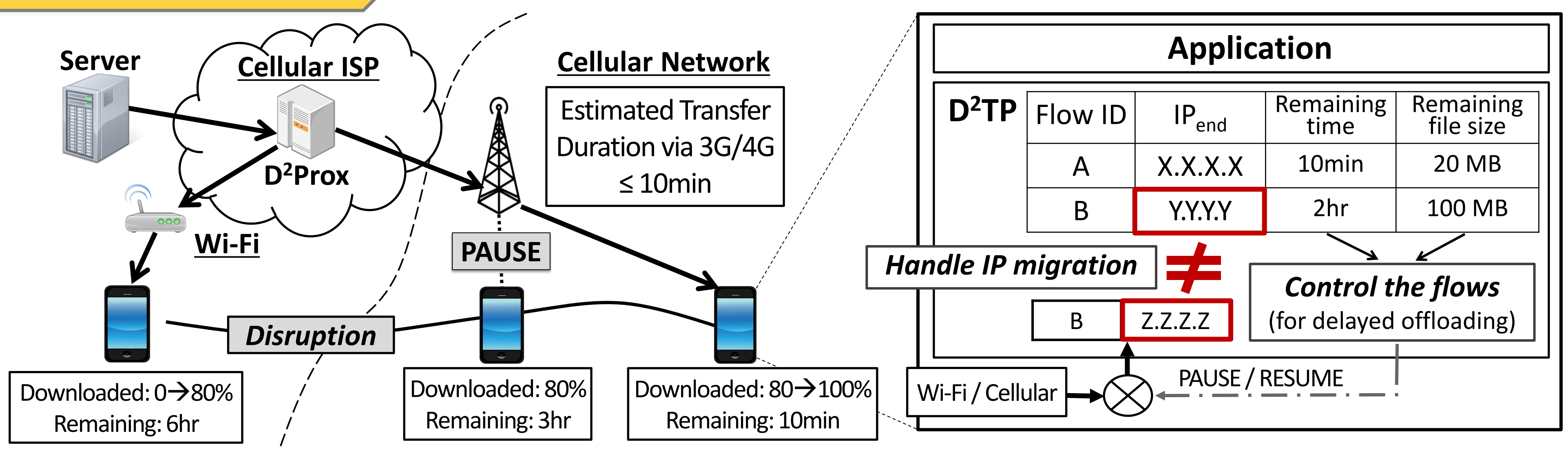
D^2TP: Delay and Disruption Tolerant Transport Layer
- Binds a persistent flow id to a connection
  - Supports seamless switching over IP address change

- Hides network disruptions from the applications

- Exploits the delays allowed by the users
  - Maximizes the Wi-Fi offloading efficiency
 - But completes transmission within allowed delay

D^2Prox: Protocol Translation Proxy
- A web caching proxy bridging D^2TP and TCP

- Data delivery via opportunistic connection
  - In a store-and-forward manner

- Easy to migrate existing HTTP apps
  - Requires no modification on existing servers

Applications

ReadyCast (Podcast downloader)
- Designed to support delayed offloading
  - Users can specify the preferred delay
- Now available at Google Play store
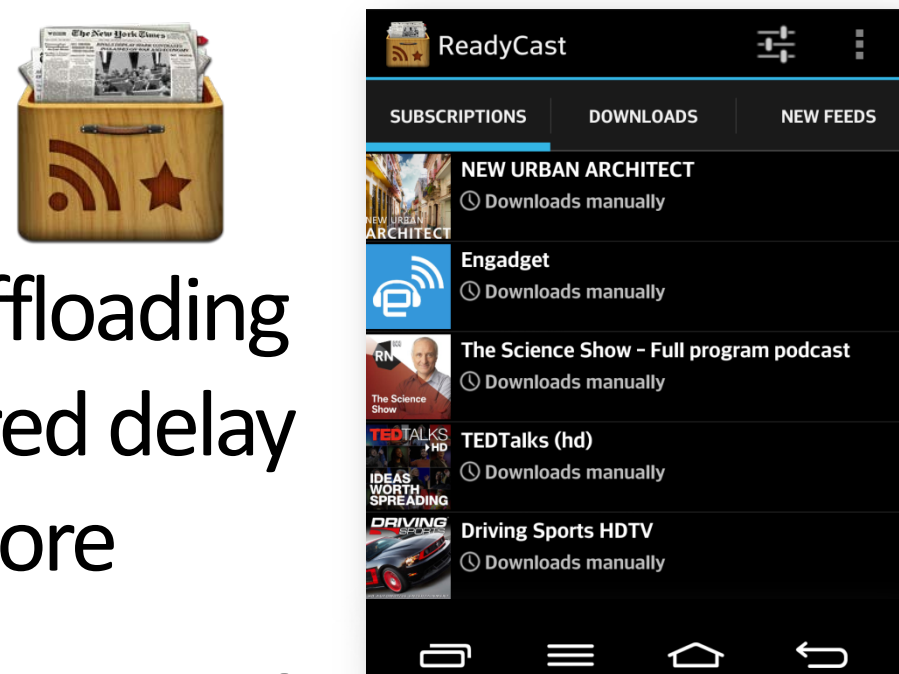
Cedos-based VLC (Video steaming player)
- Designed to support opportunistic offloading
  - Fetching the content via intermittent Wi-Fi
- Modified only 61 lines out of 3.7M lines of code

Results

User study with ReadyCast (8 weeks, 50 users)

	No delay	Delayed	Delayed	Delayed	Total
Wi-Fi Offloaded	79.5%	93.4%	96.2%	99.5%	92.4%
Delay	0	0 – 1h	1 – 3h	3 – 6h	