
Virtual Contact Sheets

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Crowdsourcing the News [1]

“When every cell phone can record video and take pictures, everyone is a potential news source.”

**Who killed
Ian Tomlinson?**

CNN: Caught Red Handed [2]



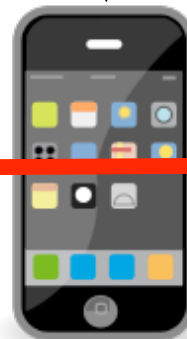
Problem

Older,
uploaded

Cloud



Recent,
not uploaded



Carnegie Mellon
Parallel Data Laboratory

<http://www.pdl.cmu.edu/>

Fundamental Mobile Challenges

- Real-time sync not possible:

How far can **we degrade the objects** in a search before it **loses meaning**?

- **Bandwidth**
 - Increasingly metered and charged

Just-in-Time Search

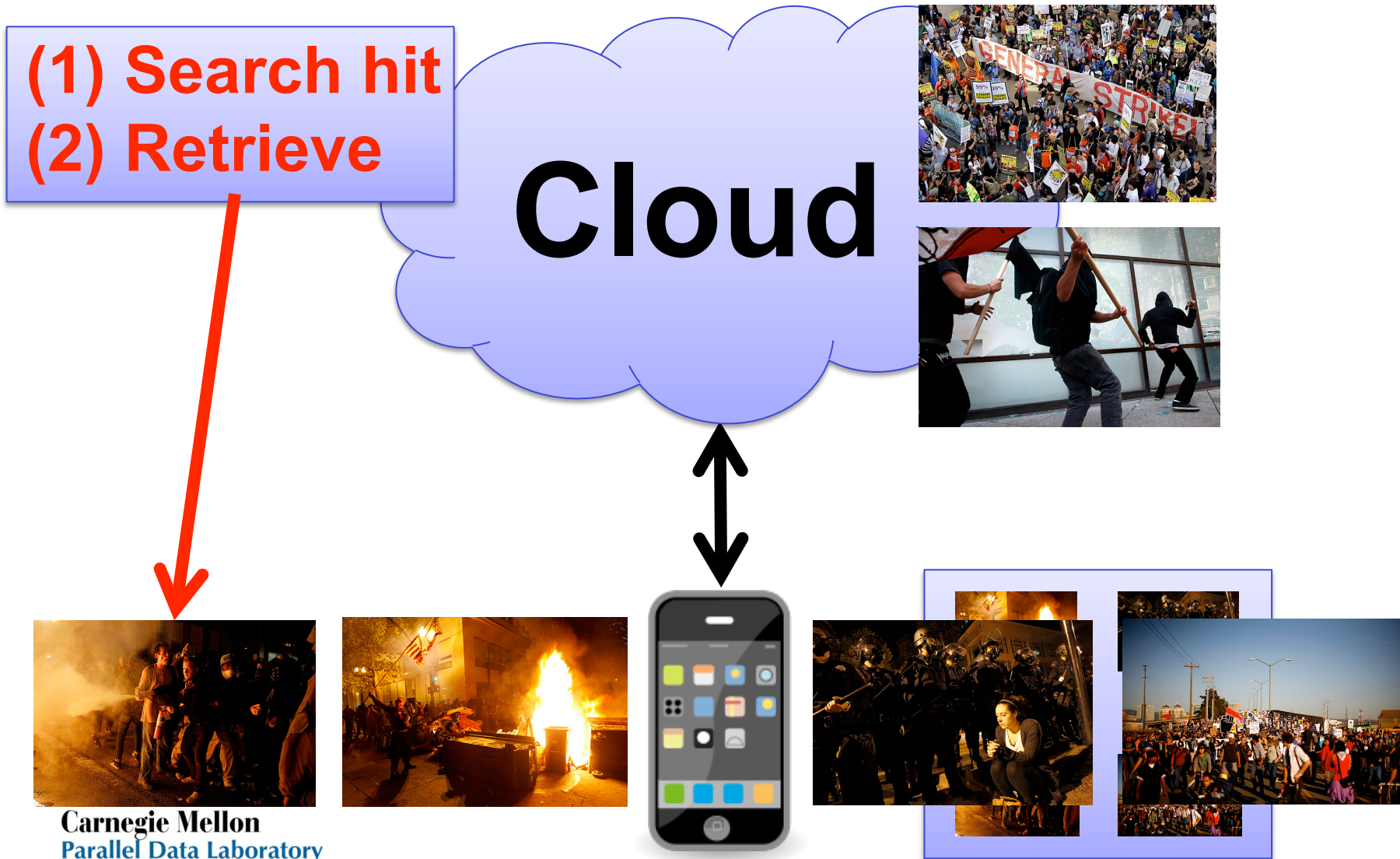
1. Check virtual contact sheet

- Collection of fidelity-reduced images in the cloud

2. Pull full fidelity image on hit

- Search full fidelity; present full fidelity results to searcher

Near Real-Time Sync

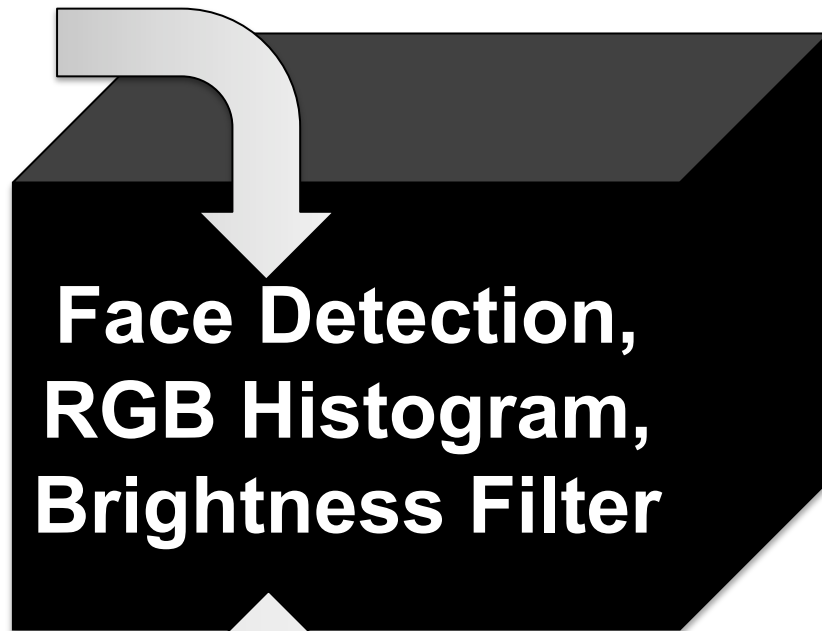


Contact Sheet Analogy



Evaluating Feasibility [3]

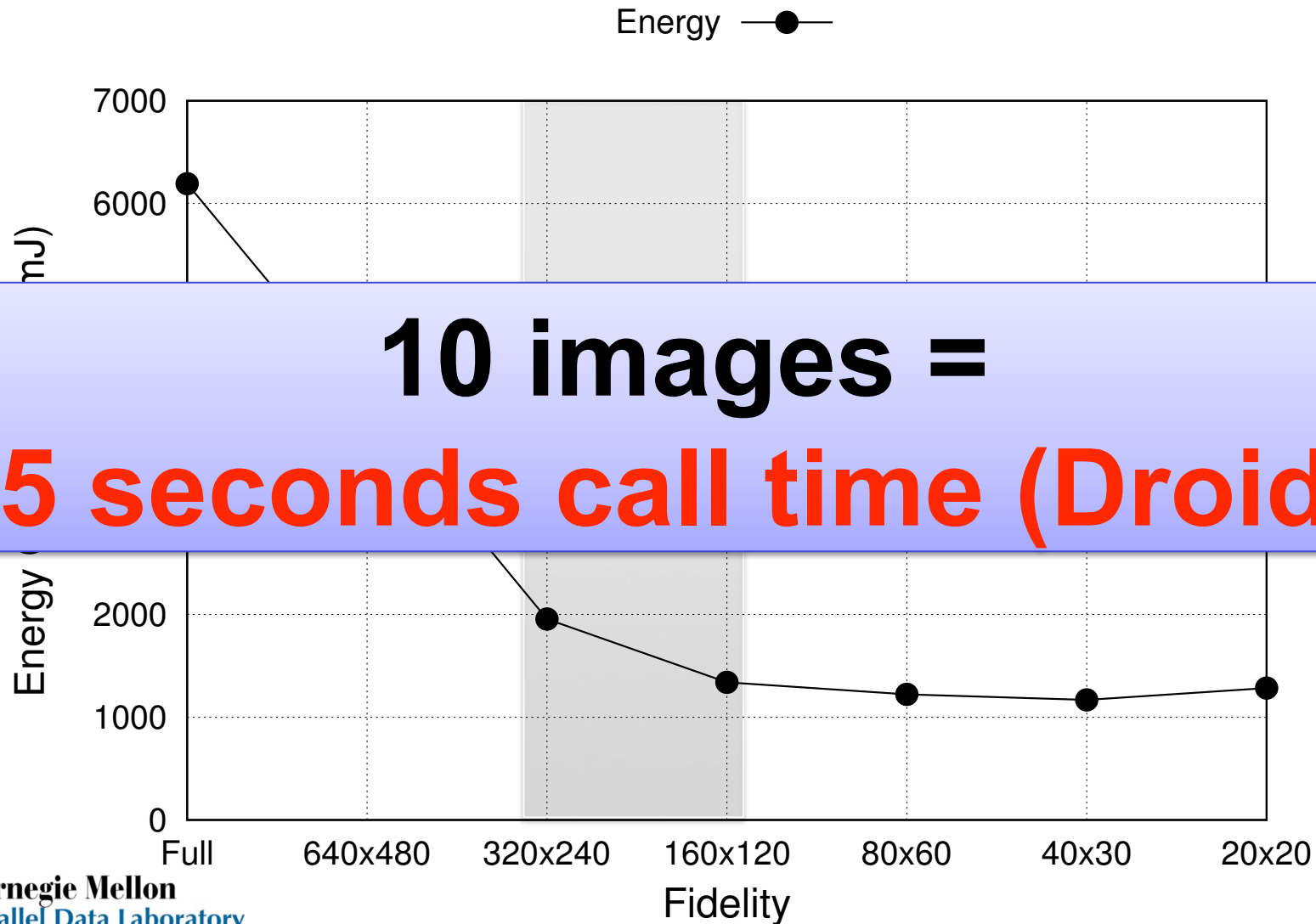
Benchmark



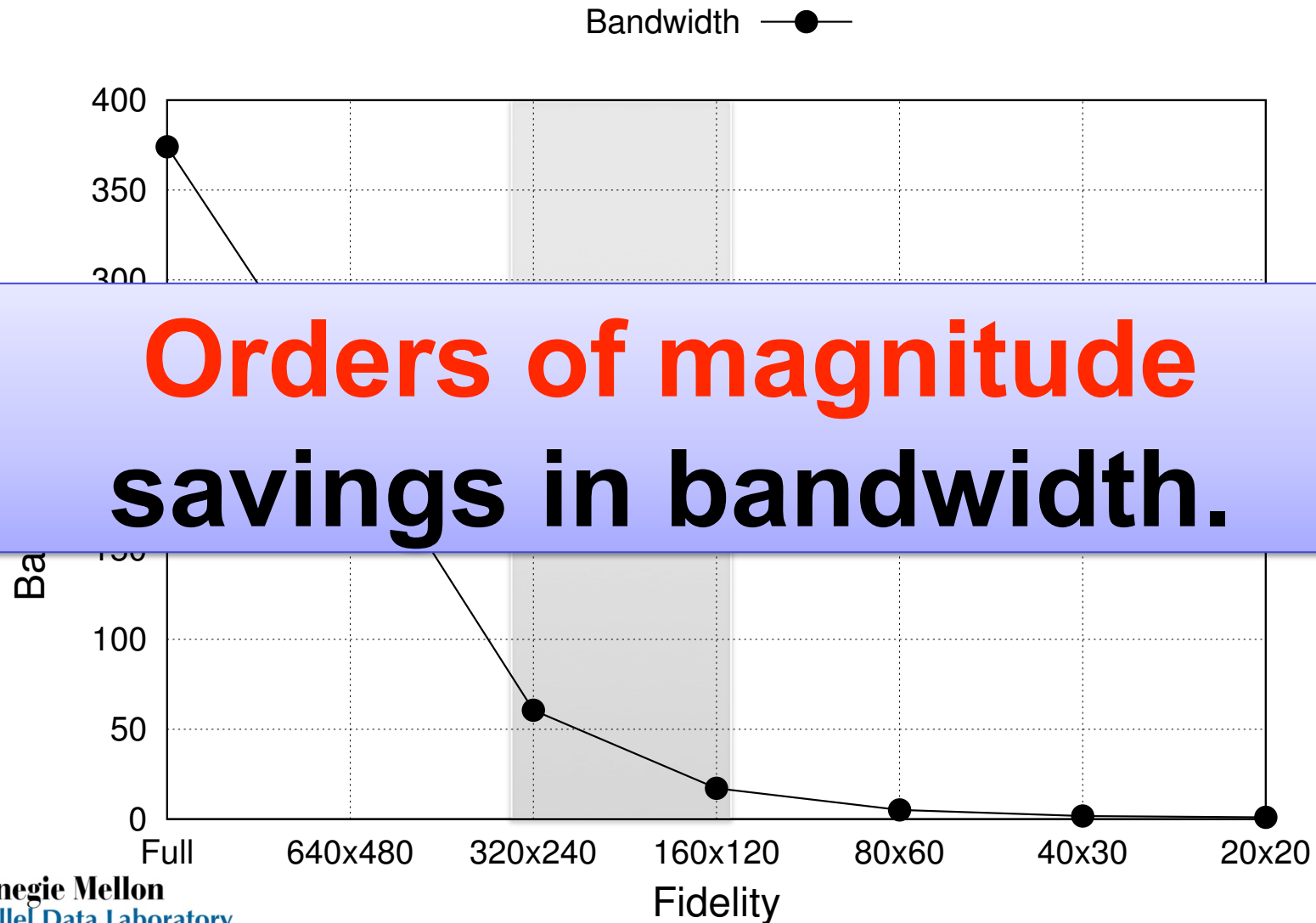
Using

**Varying Resolution
and JPEG Quality
Factor**

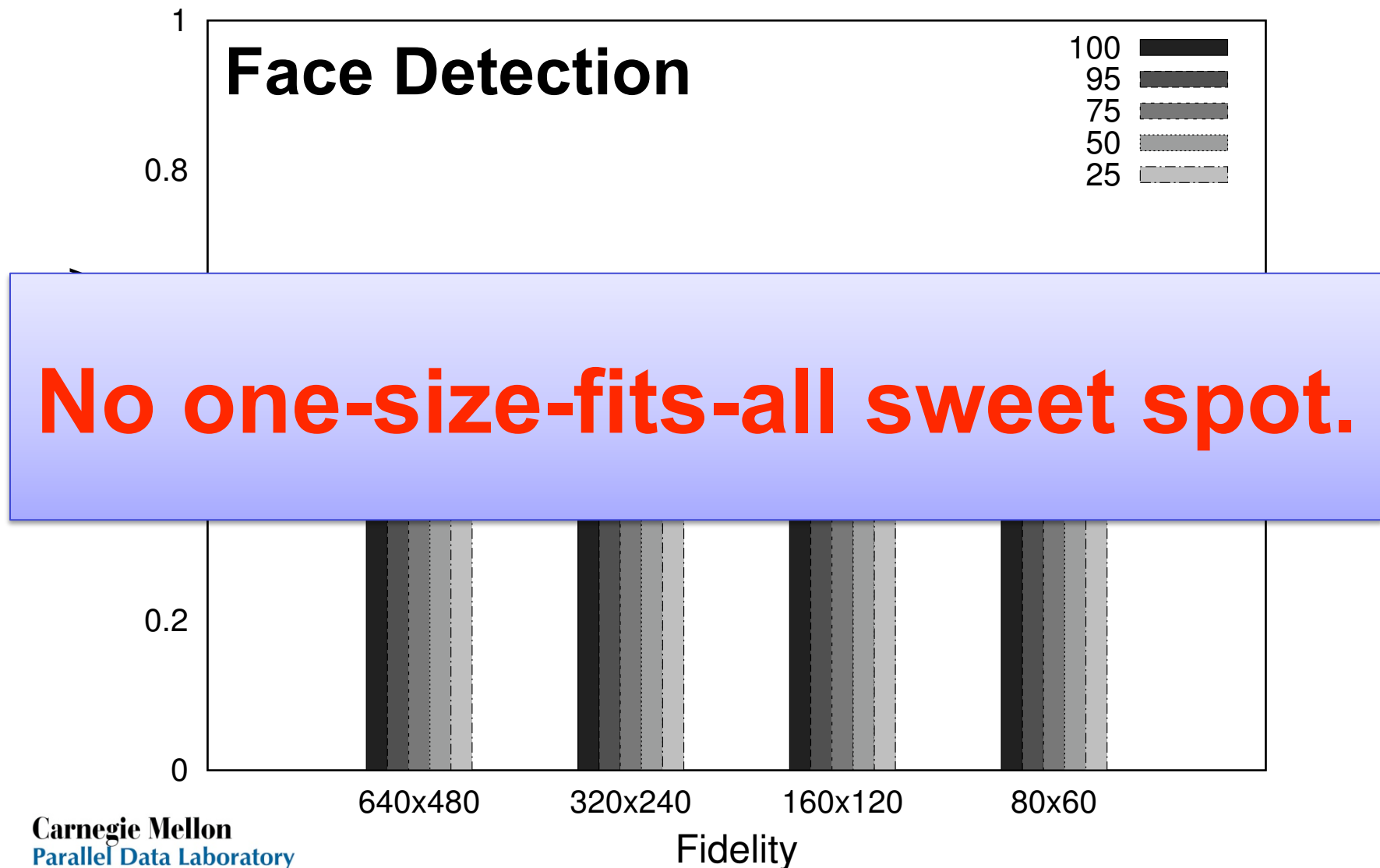
Energy Savings



Bandwidth Savings



What about Search Accuracy?



Conclusion & Future Work

- **Searches retain meaning**
 - **No one-size-fits-all, but**
 - Orders of magnitude bandwidth savings
 - Significant energy savings
- **More search primitives?**
 - Perceptual hashing
 - Face recognition
 - Texture Filters
- **Better fidelity reduction?**
 - Keep faces at high fidelity

Further Reading

[1] TED. http://www.ted.com/talks/paul_lewis_crowdsourcing_the_news.html.

[2] CNN. <http://www.cnn.com/2010/CRIME/08/24/new.jersey.theft.photo/index.html?hpt=C1>.

[3] SimpleCV. <http://simplecv.org/>.

Jan Harkes, Mahadev Satyanarayanan, Ardalan Amiri Sani, and Benjamin Gilbert. **A Contact Sheet Approach to Searching Untagged Images on Smartphones**. CMU Technical Report CMU-CS-11-132.

Ardalan Amiri Sani, Wolfgang Richter, Xuan Bao, Trevor Narayan, Mahadev Satyanarayanan, Lin Zhong, and Romit Roy Choudhury. **Opportunistic Content Search of Smartphones**. Rice University Technical Report TR0627-2011.

Xuan Bao, Trevor Narayan, Ardalan Amiri Sani, Wolfgang Richter, Romit Roy Choudhury, Lin Zhong, and Mahadev Satyanarayanan. **The Case for Context-Aware Compression**. HotMobile 2011.

Jason Flinn and Mahadev Satyanarayanan. **Energy-aware Adaptation for Mobile Applications**. SOSP 1999.

Y. Nimmagadda, K. Kumar, and Y. H. Lu. **Energy-efficient image compression in mobile devices for wireless transmission**. ICME 2009.

Full Fidelity



Average photo size: 374 KB



Reduce Resolution



Average photo size: 221 KB



JPEG Quality Factor



Average photo size: 6 KB



Bandwidth Savings Table

Resolution	100	95	75	50	25	5
640x480	221 KB	114 KB	47 KB	31 KB	19 KB	6 KB
320x240	61 KB	33 KB	14 KB	10 KB	6 KB	2 KB
160x120	17 KB	10 KB	5 KB	3 KB	2 KB	826 B
80x60	5 KB	3 KB	2 KB	1 KB	892 B	460 B
40x30	2 KB	1 KB	725 B	588 B	484 B	345 B
20x20	1000 B	727 B	501 B	436 B	385 B	316 B