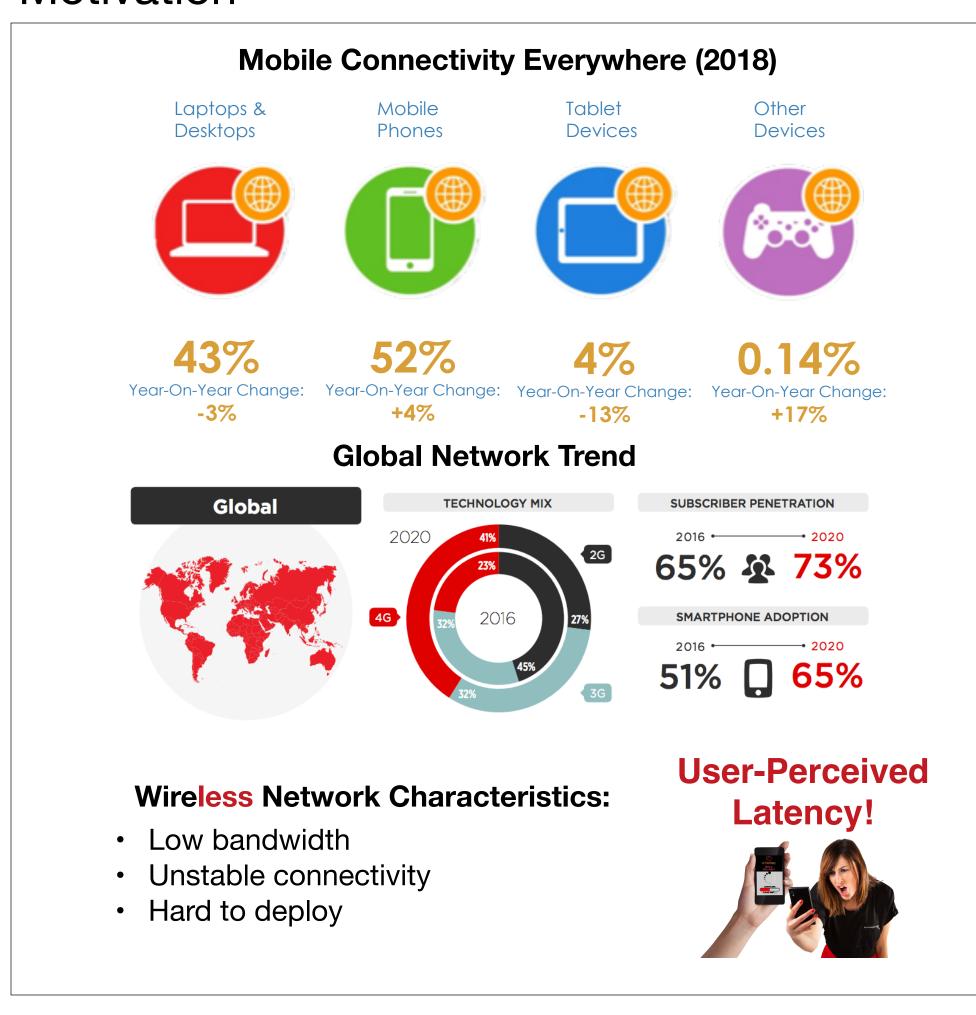
Leveraging Program Analysis to Reduce User-Perceived Latency in Mobile Applications

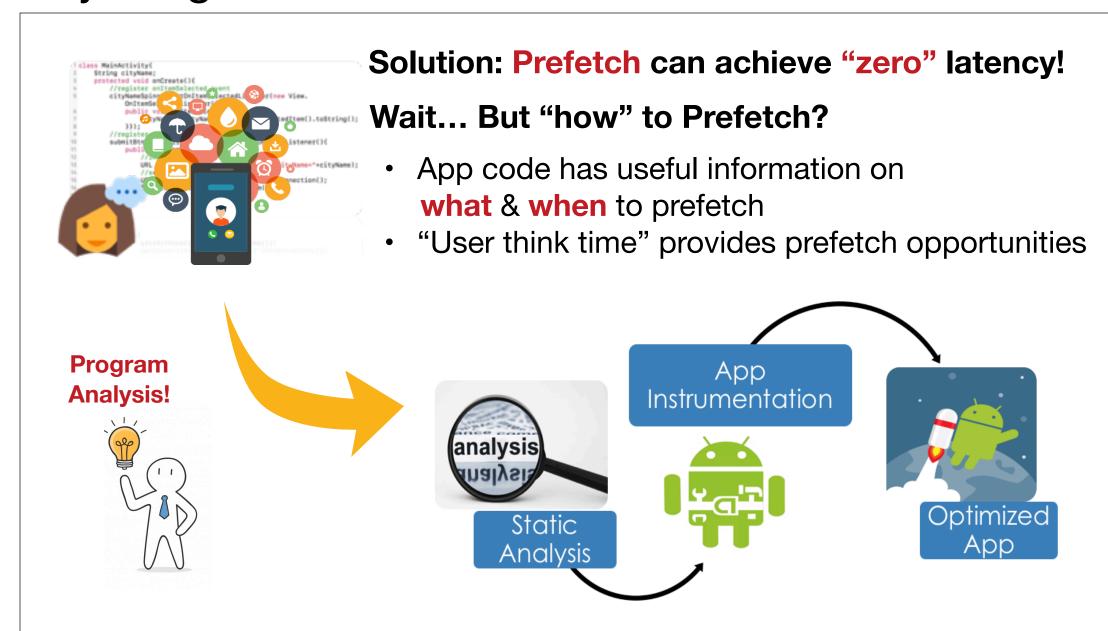
PALOMA: Program Analysis for Latency Optimization of Mobile Apps Yixue Zhao (yixue.zhao@usc.edu), Marcelo Schmitt Laser, Yingjun Lyu, Nenad Medvidović



Motivation



Key Insights



Current State of the Art

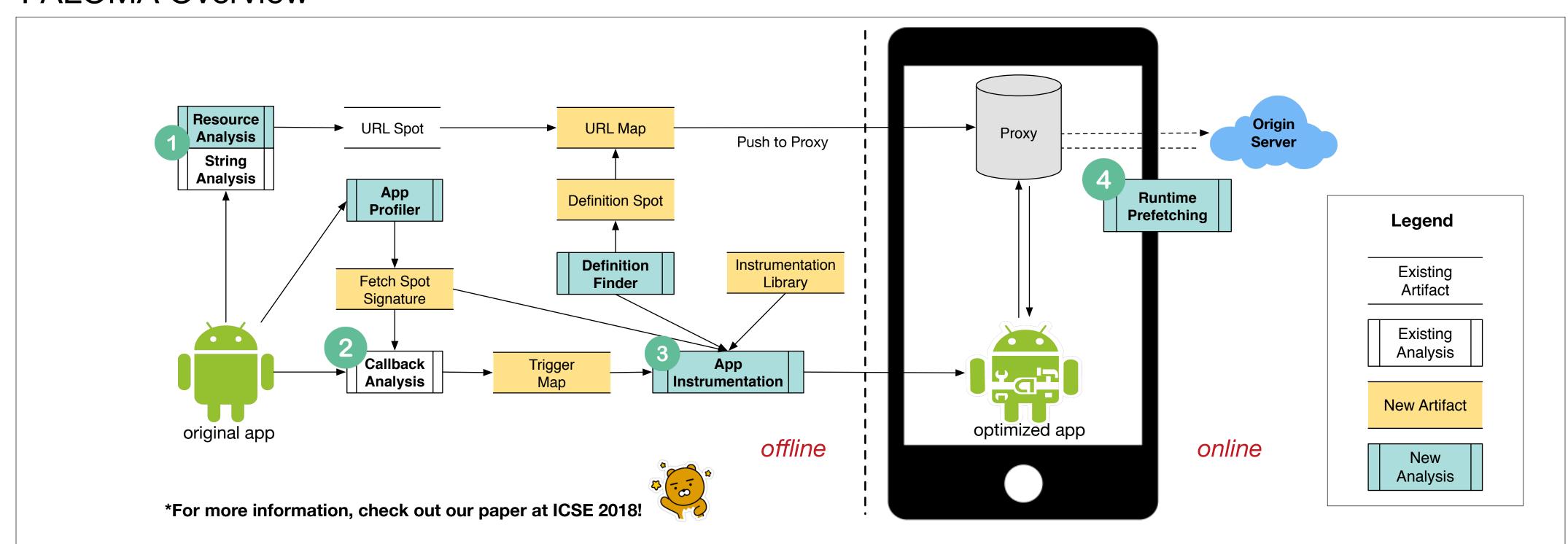
Existing Limitations:

- Server-based
- Human-based
- History-based
- Domain-based

PALOMA:

- Client-only
- Automatic
- No historical information
- Domain-independent

PALOMA Overview



Microbenchmark Evaluation

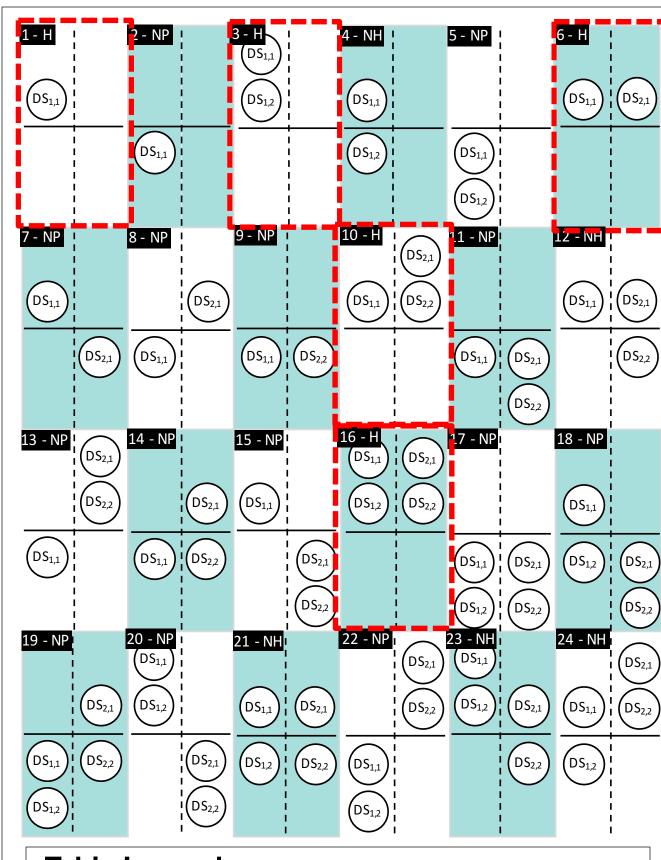


Table Legend:

SD, TP, FFP denote the runtimes of the three PALOMA instrumentation methods.

Orig is the time required to run the original app.

Red/OH represents the reduction/overhead in execution time when applying PALOMA.

Diagram Legend:

DS (Definition Spot): a code statement where the value of a dynamic URL string is defined.

H (Hit): the request is prefetched and the response is used.

NH (Non-hit): the request is prefetched but the response is **not** used.

NP (Non-prefetchable): the URL is unknown at the prefetching point.

Average Results:

- Accuracy 100%
- Avg latency reduction 99.47%
- Avg overhead 6.44ms

Detailed Results for Hit Cases

Case	SD (ms)	TP (ms)	FFP (ms)	Orig (ms)	Red/OH
0	N/A	2	1	1318	99.78%
1	0	5	0	15495	99.97%
3	1	4	1	781	99.24%
6	1	4	2	661	98.95%
10	1	5	0	592	98.99%
16	1	11	0	8989	99.87%

Real App Evaluation

- 32 apps from Google Play store
- 4G network
- 2 Android users

Results across the 32 apps

	Min.	Max.	Avg.	Std. Dev.
Runtime Requests	1	64	13.28	14.41
Hit Rate	7.7%	100%	47.76%	28.81%
Latency Reduction	87.41%	99.97%	98.82%	2.3%

Road Ahead

- Lay the foundations for program analysis-based prefetching techniques
- Balance QoS trade-offs
- Study user behaviors
- Extend to other latency-hogging operations



References

- 1. Yixue Zhao, "Toward Client-Centric Approaches for Latency Minimization in Mobile Applications." MOBILESoft 2017.
- 2. Yixue Zhao, Marcelo Schmitt Laser, Yingjun Lyu, Nenad Medvidovic, "Leveraging Program Analysis to Reduce User-Perceived Latency in Mobile Applications." ICSE 2018.
- 3. Sources of the statistics of mobile network: https://wearesocial.com, http://www.gsma.com.