

INTERRUPTIBILITY RESEARCH: OPPORTUNITIES FOR FUTURE FLOURISHMENT

Tadashi Okoshi

Keio University

slash@ht.sfc.keio.ac.jp

Jin Nakazawa

Keio University

jin@sfc.keio.ac.jp

Hideyuki Tokuda

Keio University

hxt@sfc.keio.ac.jp

HERBERT A. SIMON (1916-2001)

American political scientist, economist, sociologist, psychologist, and computer scientist
a Nobel Prize laureate. Professor in Carnegie Mellon University



*“in an information-rich world, the wealth of information means a dearth of something else: a scarcity of whatever it is that information consumes. What information consumes is rather obvious: **it consumes the attention of its recipients.** Hence a wealth of information creates a poverty of attention and a need to allocate that attention efficiently among the overabundance of information sources that might consume it.”*

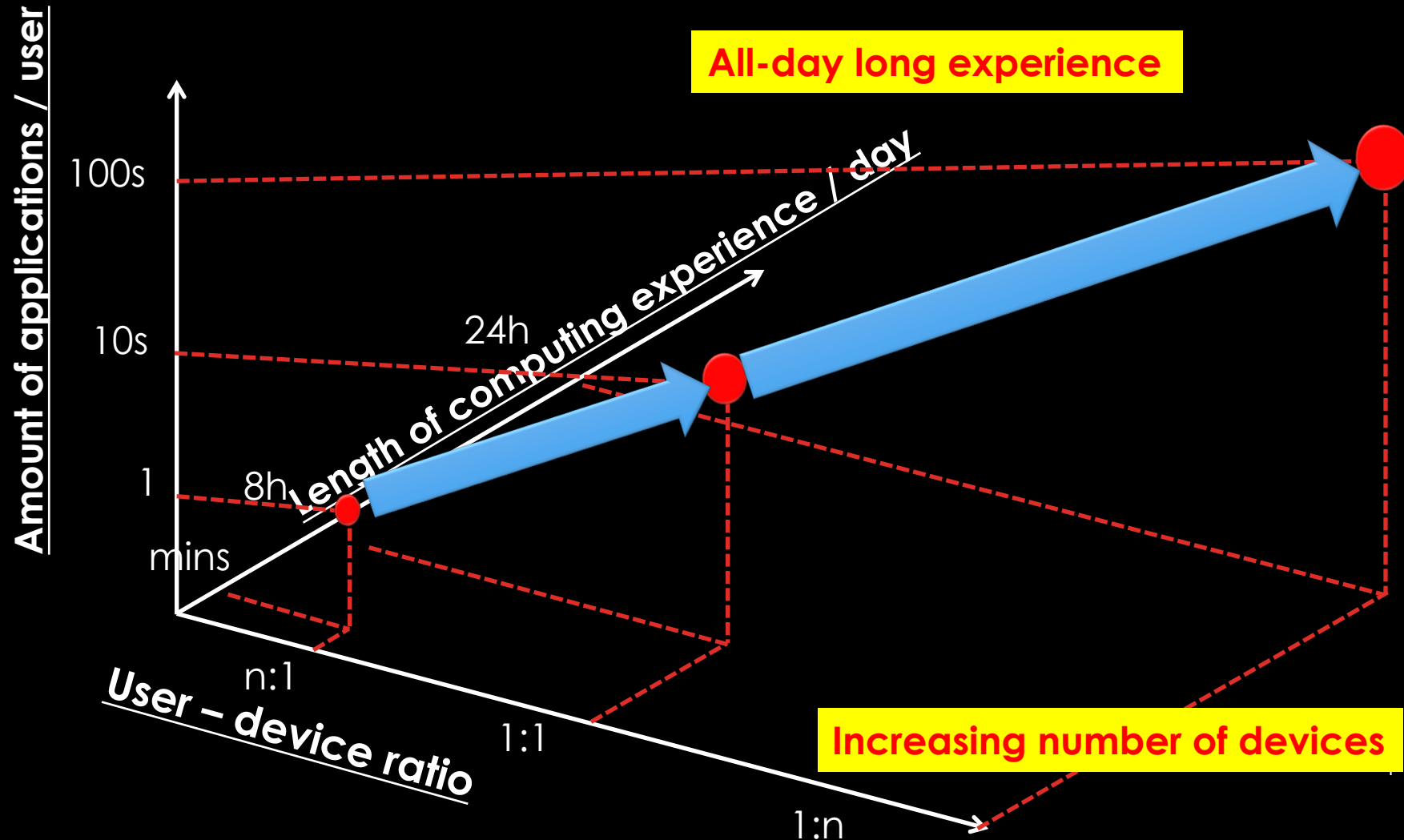
H. A. Simon. Designing organizations for an information-rich world. *Computers, communication, and the public interest*, 37:40–41, 1971.

RECENT TREND IN OUR COMPUTING RELATED TO NOTIFICATIONS

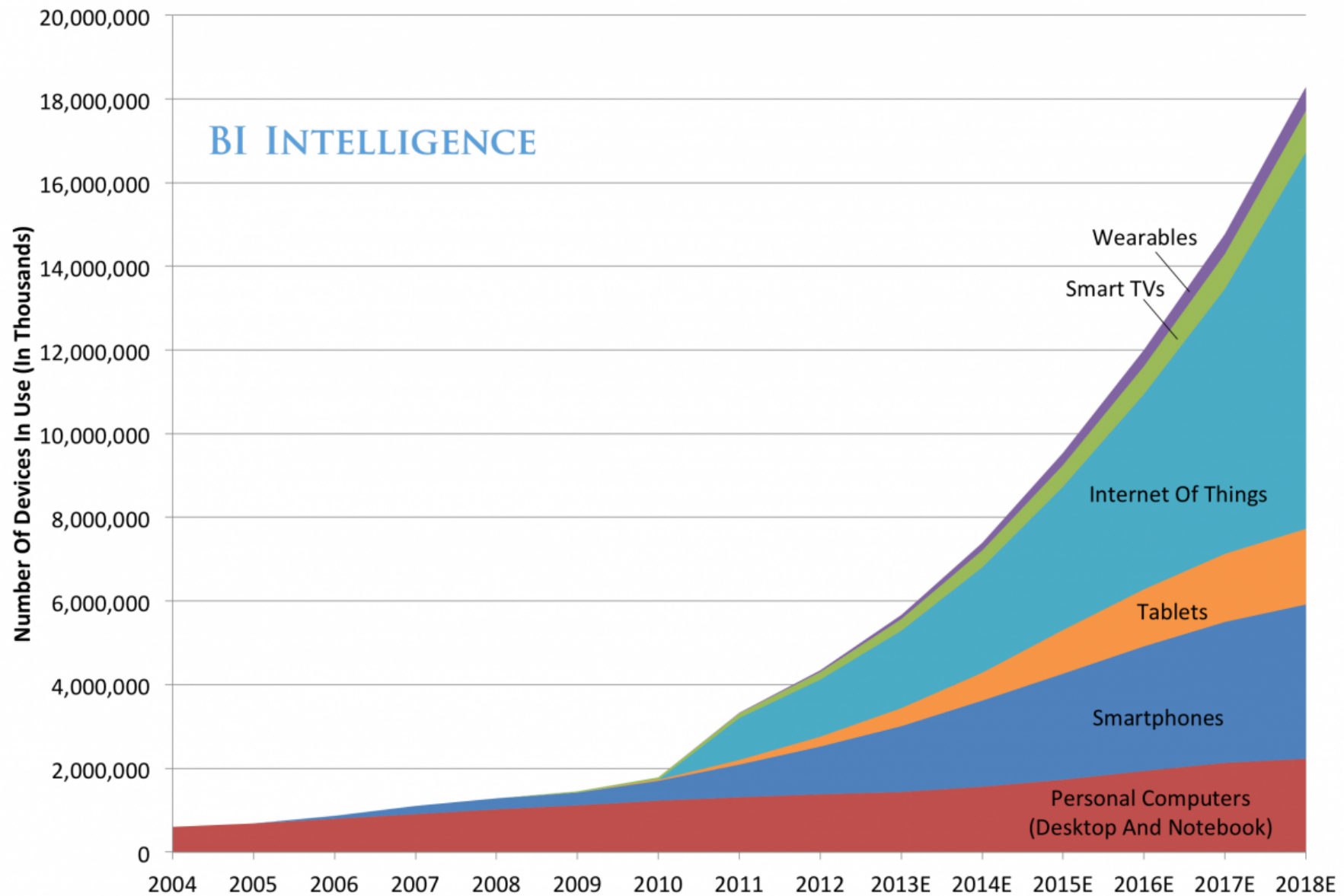
- Increasing connected devices
- Increasing applications and services, connected others
- Users' all-day long computing experience

PROGRESS OF UBIQUITOUS COMPUTING

With large number of applications



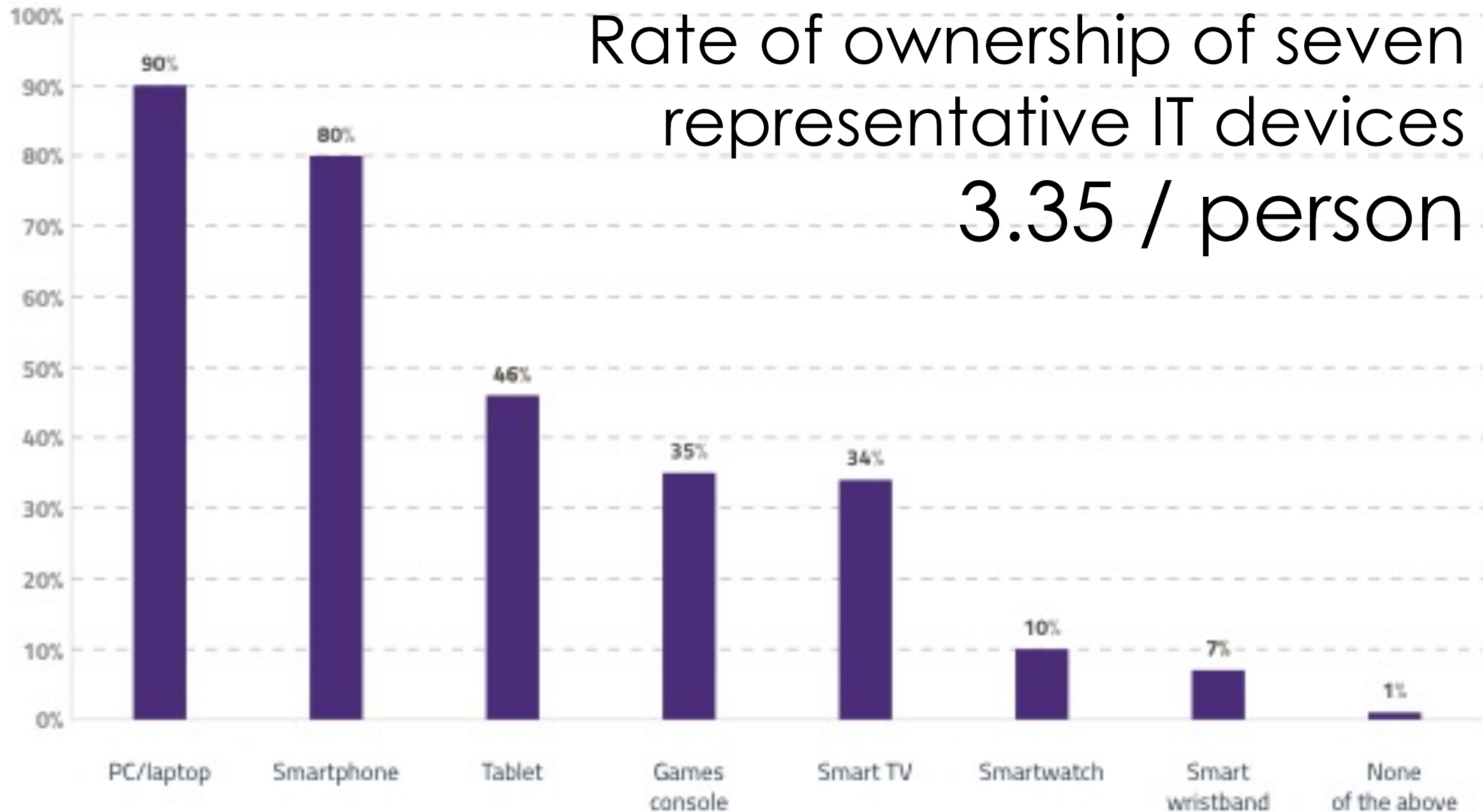
Global Internet Device Installed Base Forecast



Source: Gartner, IDC, Strategy Analytics, Machina Research, company filings, BII estimates

Source: BI Intelligence

Rate of ownership of seven representative IT devices 3.35 / person

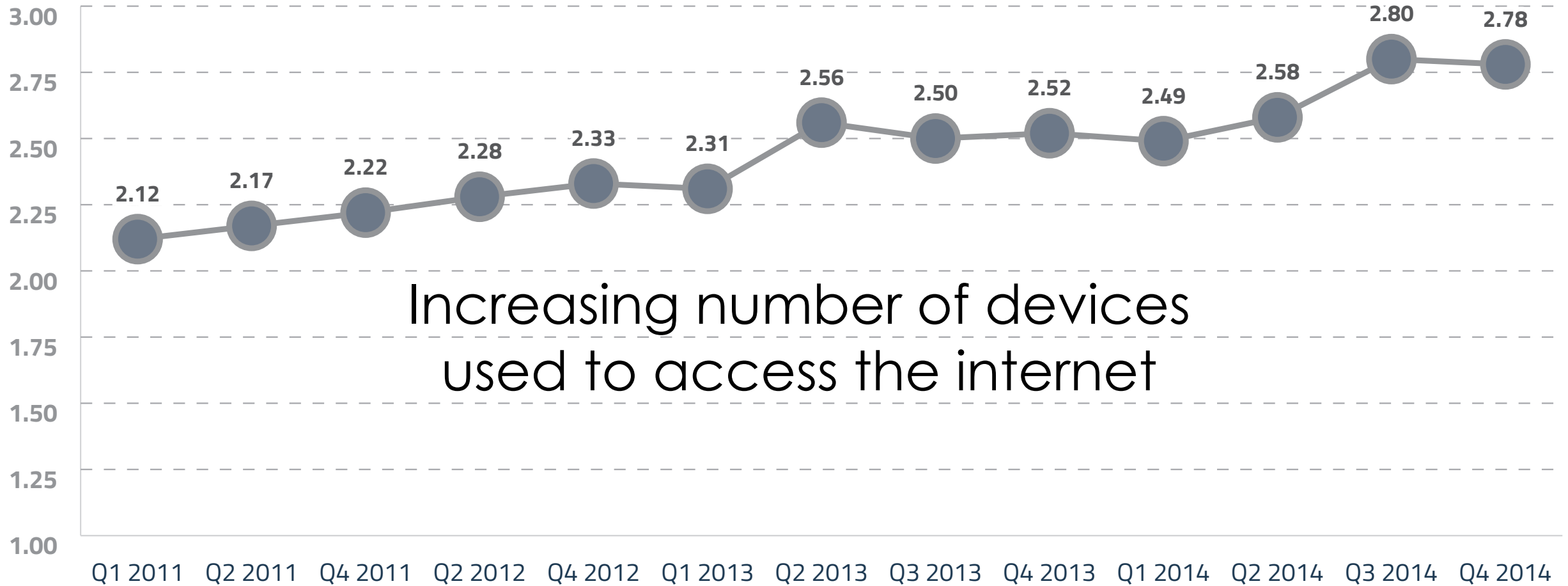


By GlobalWebIndex (2014)

Targeted to the Internet users aged 16 to 64. The rate of ownership of seven representative personal IT devices: a PC/laptop, smartphone, tablet, game console, smart TV, smart watch, and smart wristband.

The average number of devices owned per person is 3.35 (worldwide)

Source: Trendstream Limited. Multi-device owners - gwi trends Q1 2015. <https://app.globalwebindex.net/products/report/multi-device-owners-q1-2015>, 2015



Increasing number of devices
used to access the internet

The average number of devices that people are using to access the Internet. Increasing from 2.12 (2011) to 2.78 (2014)

MORE AND MORE APPS/SERVICES!

2million apps (was 1.5m in 2015)

130 billion total downloads (was 100billion in2015)

(Source: Apple WWDC 2016

<http://jp.techcrunch.com/2016/06/14/20160613apples-app-store-hits-2m-apps-130b-downloads-50b-paid-to-developers/>)



Available on the
App Store



Google play

2million apps

<http://www.statista.com/statistics/266210/number-of-available-applications-in-the-google-play-store/>

PEOPLE'S "APP BEHAVIOR"



- **95 apps on the phone**

Yahoo Aviate's research has shown that smartphone users on average install 95 applications on their phone and use 35 of them throughout the day [92].

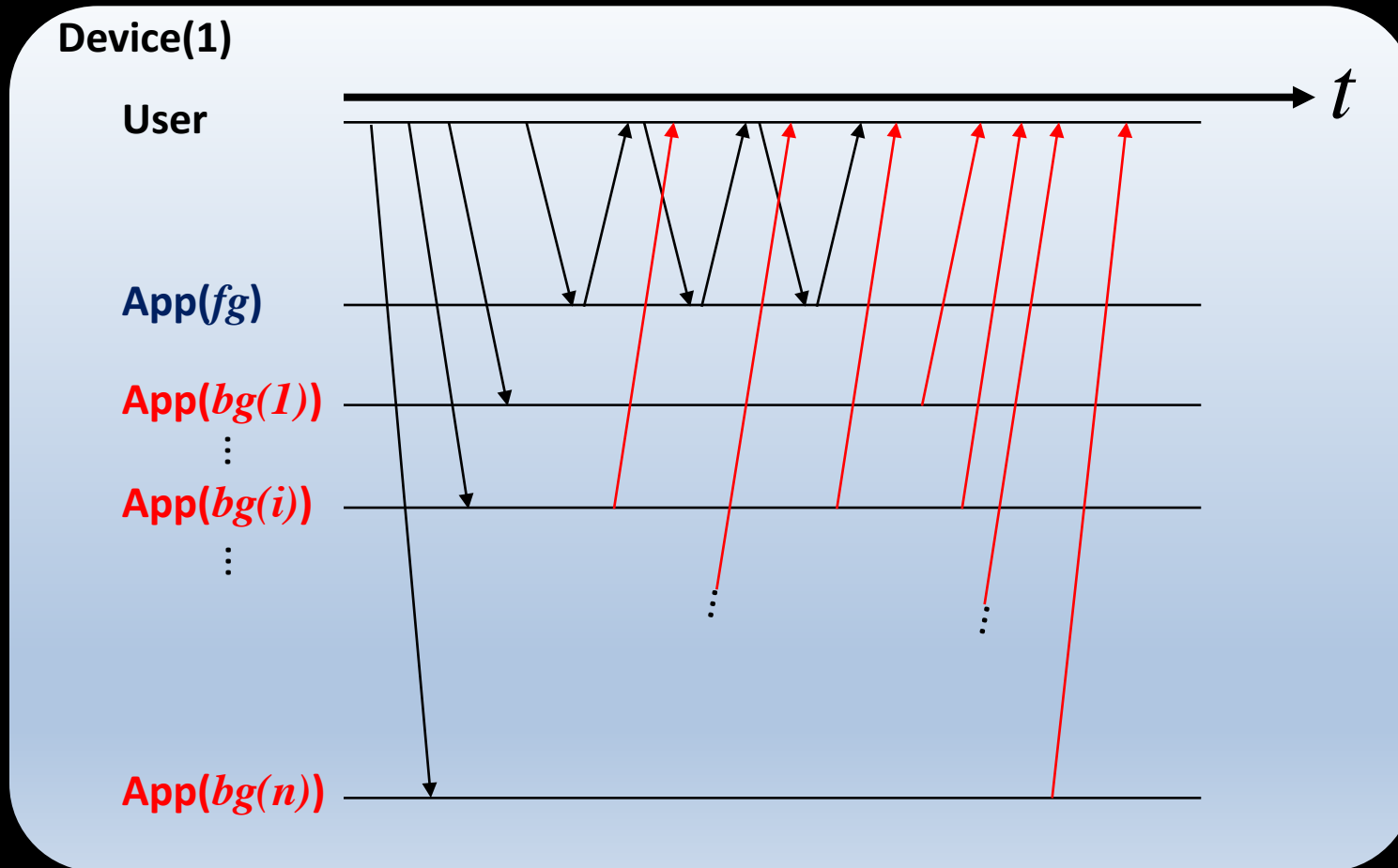
- **8.9 app downloads per month**

Research [25] has shown that users continuously download new applications. Even in one of the most mature app markets in the U.S.A., consumers have been continually downloading applications at the same rate since 2011 (8.9 apps per month in 2011 versus 8.8 apps per month in 2014).

OUR COMPUTING IS GETTING 24H/DAY



RECENT TRENDS IN NOTIFICATION

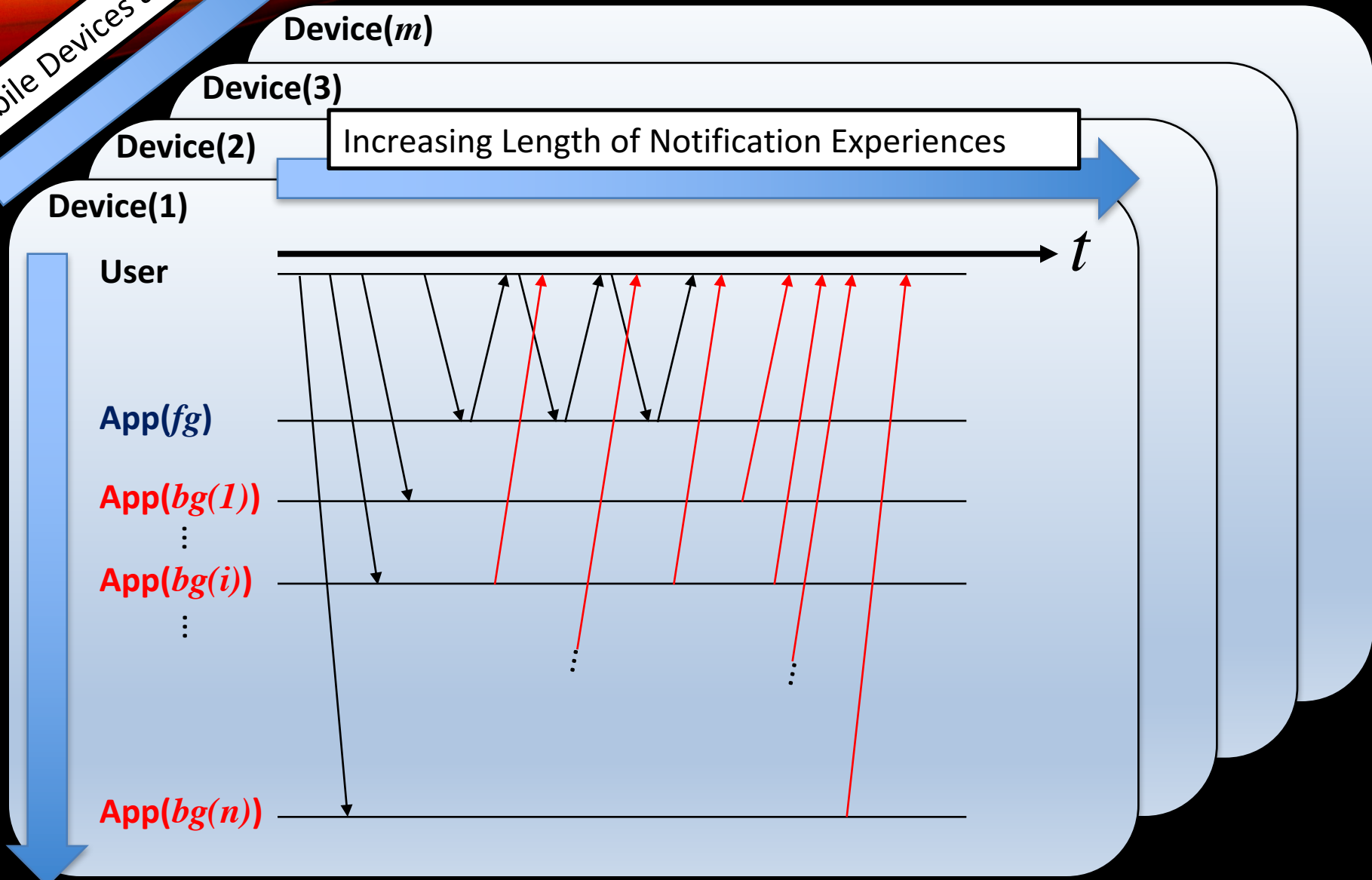


RECENT TRENDS IN NOTIFICATION

Multiple Mobile Devices as Targets

Increasing Notifications from Versatile Sources

Increasing Length of Notification Experiences



4 DESIGN PRINCIPLES FOR ATTENTION-SENSING

Backgrounds  **Principles**

① Increasing number of devices

① Feasibility on user's multiple devices

② Increasing number of applications

② Applicability to diverse notification source apps

③ All-day long experience

③ Affinity to user's all-day long use

④ Real-time detection for on-the-fly adaptation

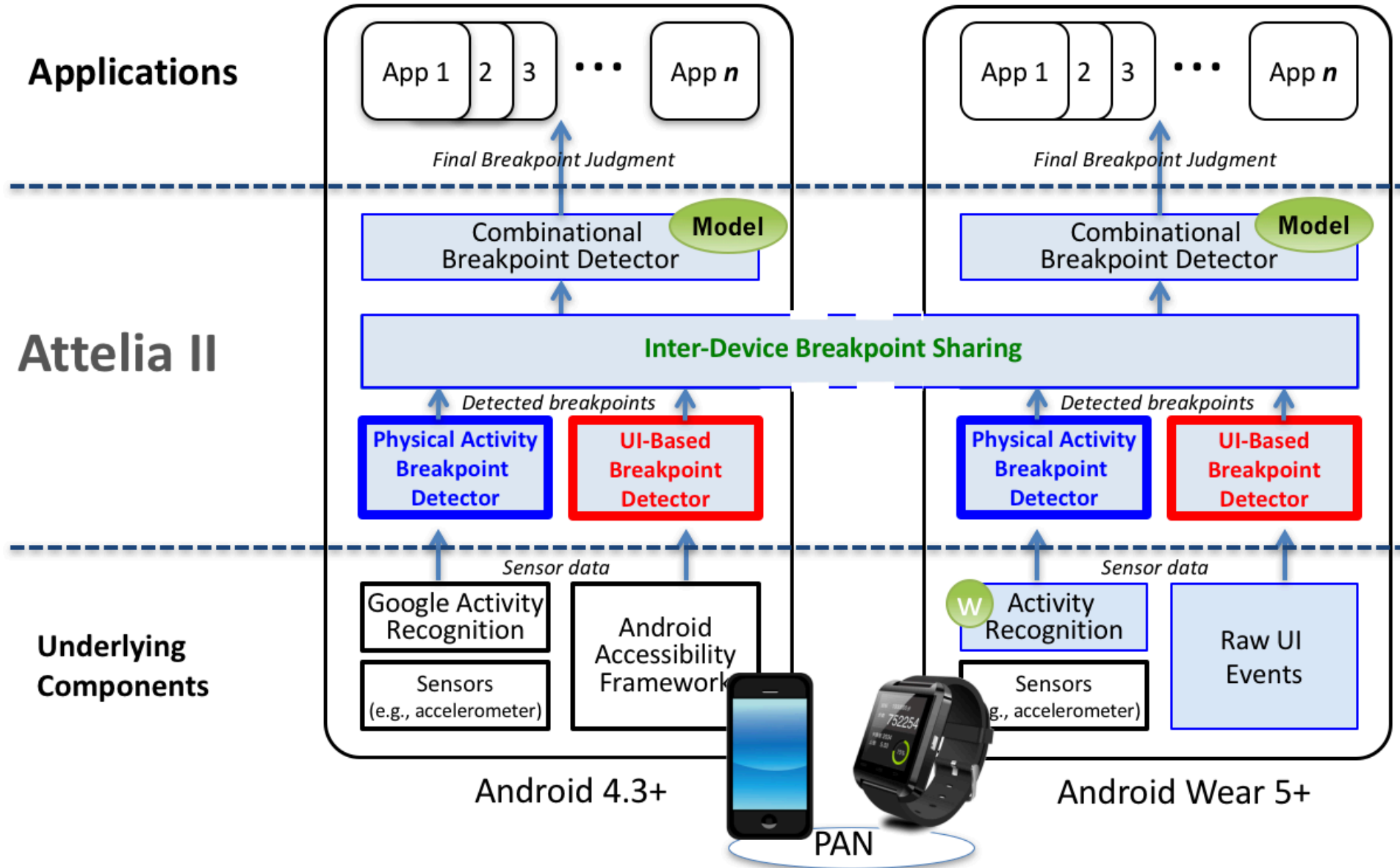
At ATTELIA

- is a middleware system
- for detecting user's "interruptive moment"



- *in real-time*
- on user's *mobile and wearable devices*
(Not needing external physiological sensors)
- covering user's "comprehensive computing situations"
- *w/o modification to existing applications and OSs.*

Attelia II System Architecture



PROPOSAL

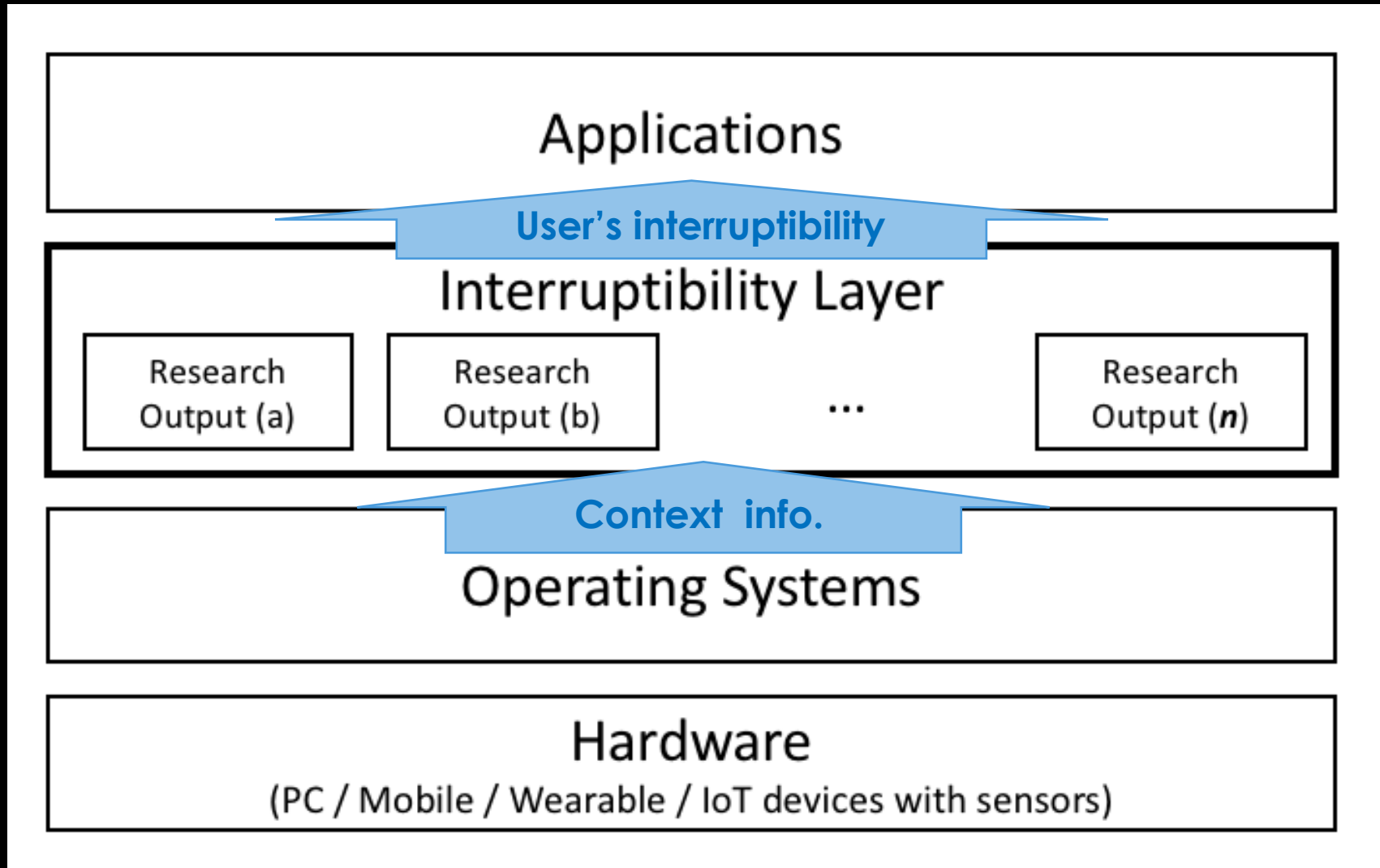
We propose 3 distinctive research directions towards further flourishing of interruptibility re- search area, as follows.

- “Be a layer. Be a platform”
- Communication with industries
- Intersection with other research fields

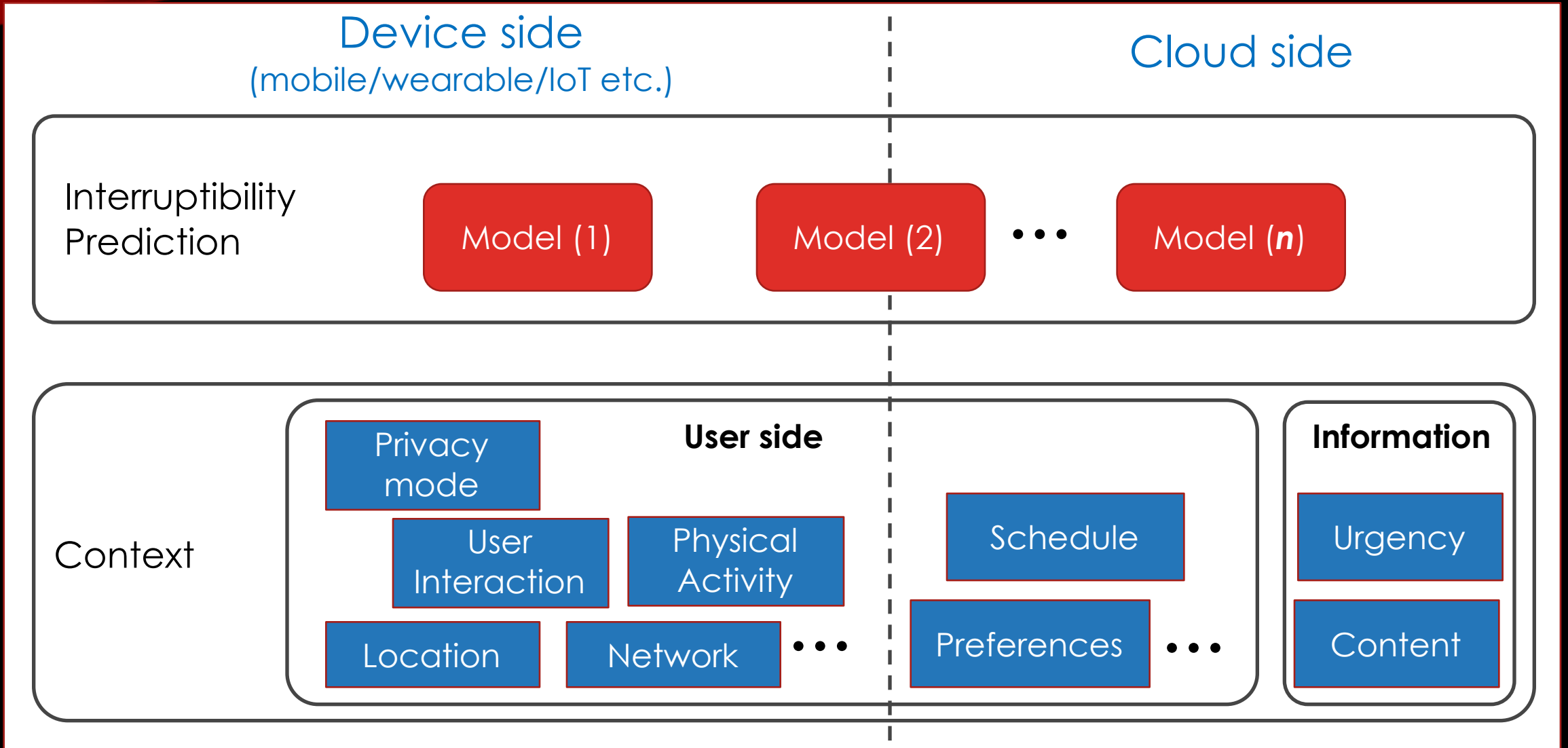
1. “BE A LAYER. BE A PLATFORM.”

- Very few works [16, 14, 15] implemented their interruptibility detection system as a platform software (e.g., “interruptibility API”).
 - (1) interruptibility researchers have difficulty in comparing the proposed methods each other.
 - (2) potential users of those interruptibility research outputs need burden to evaluate and utilize those outputs.
- Providing the series research output (implementation of proposed methods) in this field to other researchers and developers by a means of “layering”.

“INTERRUPTIBILITY LAYER”



“INTERRUPTIBILITY LAYER”



AWARE FRAMEWORK

<http://awareframework.com>

AWARE

Android Mobile Context Instrumentation Framework

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What is AWARE?

AWARE is an Android instrumentation framework for logging, sharing and reusing mobile context. It comes bundled with applications that understand YOU.

[Read more](#)

AWARE is available for



Android 2.3.x+
[Download Source](#)



iOS 8+
[Download Source](#)



OSX 10.8+
[Download Source](#)

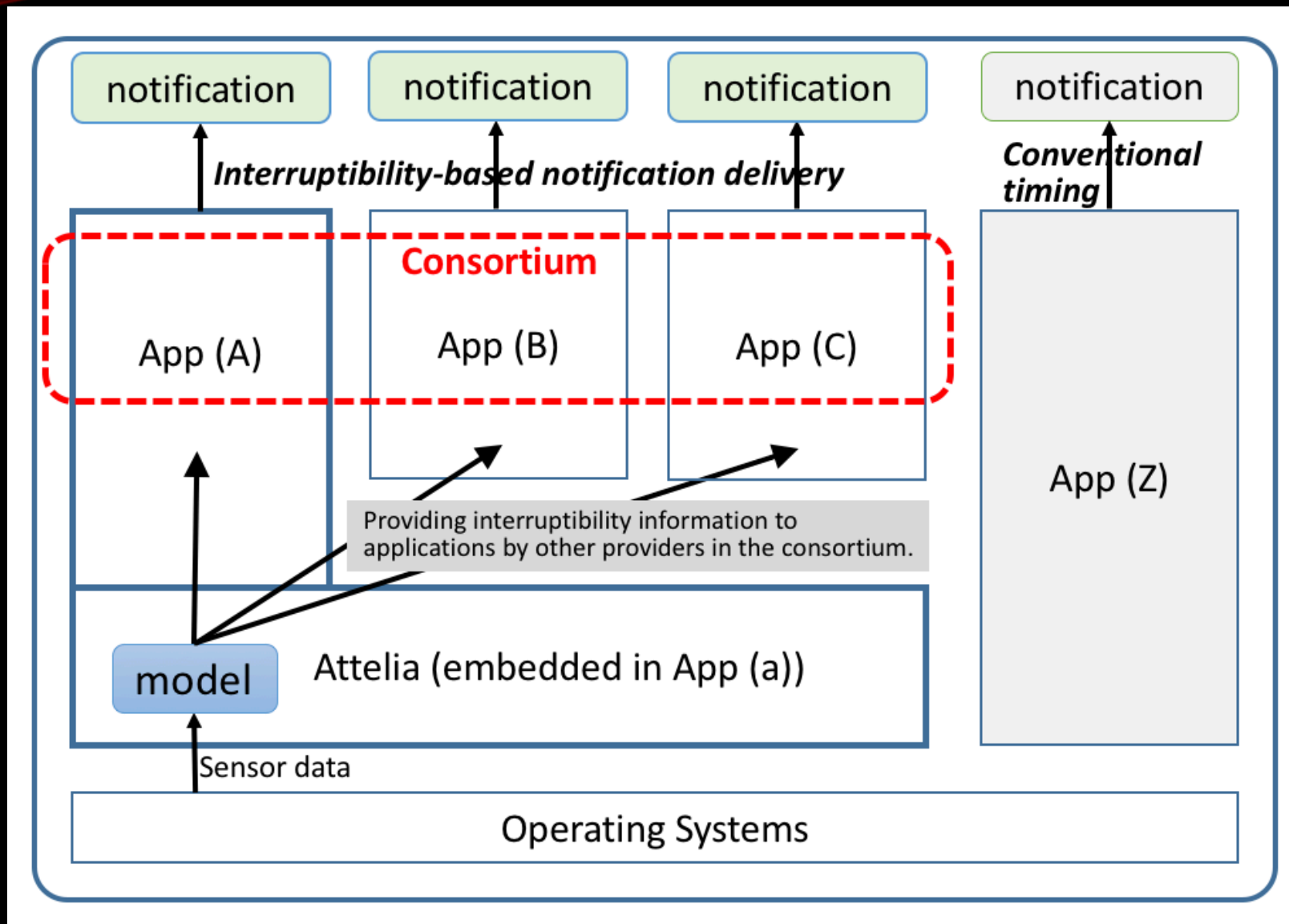


Server
[Download Source](#)

2. COMMUNICATION WITH INDUSTRIES

- Google (Android) and Apple (iOS)
 - API to “control” (not retrieving) notifications are not opened by the platforms.
 - This has been obstacles for many researchers to do mobile interruptibility study with “real” applications and “real” notifications.
- (a) Why don't we talk to Google and/or Apple?
- (b) Even on top of “the moving target” platforms, open “interruptibility layer” middleware can collaborate with application developers

INTERRUPTIBILITY CONSORTIUM IN APP LAYER



CONCLUSION

- Observation on notification-related recent trends in computing
 - More devices
 - More applications and services
 - “All-day” computing experience
- Proposal
 - “Be a layer. Be a platform”
 - Communication with industries
 - Intersection with other research fields



Tadashi Okoshi
Keio University
slash@ht.sfc.keio.ac.jp

CREDITS (IMAGES)

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