Mobile Commerce: What Will the App Store of the Future Look Like?

Norman Sadeh

Director, Mobile Commerce Lab. School of Computer Science Carnegie Mellon University



Explosion in Mobile Device Ownership



Source: http://www.smartone.com.hk/about/investor/results/english/0910interim_present.pdf

Orders of Magnitude (US only)



•Over \$40B/year in mobile <u>data</u> revenue

•Approx. 25% of all wireless revenues in US (late 2009)



Trust & Usability: Beyond the Access Device

- By 2007, WAP and J2ME were widely available already but...
 - Typing a URL in a mobile browser remained a challenge
 - Expecting users to download and pay for apps was unrealistic
 - Usability issues: Finding the app & downloading it
 - □ **Trust issues**: "I'm not giving my credit card details to this company I never heard of"

Copyright © Norman Sadeh, 2005-2010

The Advent of the App Store Model

Addresses key usability and trust issues:

- Directory & search functionality
- Ratings
- Payment
- Content quality, including security



Copyright © Norman Sadeh, 2005-2010

The App Store Today

- □ 50M iPhones, 35M iPod Touch, 1M iPads
- Around 200,000 apps today
- Over 4 billion downloads
- Users spend an average of 30 minutes a day interacting with apps
 - Source: Apple
- ...and a number of others have followed
 - Android Market, Symbian Ovi, etc.

Another Measure of Success

Eating up 3x as much data share per phone sold

Android, like the iPhone, is making a data impact around three times its share of unit sales, while other popular platforms are used to access data less than their sales would suggest.

Global Gales by Flatform	Q3 2008 Units	Share	Q3 2009 Units	Share	Unit Sales by Pla	atform	
Symbian	18,583,060	46.6	20,722,052	46			
RIM BlackBerry	6,051,730	15.2	10,361,026	21	3%		Symbian
Apple iPhone	6,899,010	17.3	4,558,851	18	9% 3%		 RIM BlackBerry
Microsoft Windows Mobile	5,425,470	13.6	2,901,087	8.8	18%	46%	Apple iPhone
Google Android	0	0	1,243,323	3.5	1070		Windows Mobile Google Android
Other (Palm, Linux)	2,890,830	7.3	1,657,764	3	0401		Other
Total	39,850,100	100	41,444,104	100	21%		
	September 2009 Share		October 2009 Share		Data Traffic by Platform		
Global Traffic by Platform **	September 2009	Share	October 2009 S	share	Data Traffic by Pl	atform	
Global Traffic by Platform ** Apple iPhone	September 2009	Share 43	October 2009 S	Share 50	Data Traffic by Pl	atform	
Global Traffic by Platform ** Apple iPhone Symbian	September 2009	Share 43 29	October 2009 S	50 25	Data Traffic by Pl	atform	
Global Traffic by Platform ** Apple iPhone Symbian Google Android	September 2009	Share 43 29 10	October 2009 S	50 50 25 11	Data Traffic by Pl 3% 7%	atform	Apple iPhone
Global Traffic by Platform ** Apple iPhone Symbian Google Android RIM BlackBerry	September 2009	Share 43 29 10 8	October 2009 S	50 50 25 11 7	Data Traffic by Pl. 3% 7% ⁴ % 11%	atform	 Apple iPhone Symbian Google Android
Giobal Traffic by Platform ** Apple iPhone Symbian Google Android RIM BlackBerry Windows Mobile	September 2009	Share 43 29 10 8 5	October 2009 S	50 50 25 11 7 3	Data Traffic by Pl 3% 7% ⁴ % 11%	atform 50%	 Apple iPhone Symbian Google Android RIM BlackBerry
Giobal Traffic by Platform ** Apple iPhone Symbian Google Android RIM BlackBerry Windows Mobile Other	September 2009	Share 43 29 10 8 5 5	October 2009 S	50 50 25 11 7 3 4	Data Traffic by Pl 3% 7% 4% 11% 25%	atform	 Apple iPhone Symbian Google Android RIM BlackBerry Windows Mobile

An Increasingly Rich Ecosystem

- □ Thousands of location-based apps
- □ Social networking apps
- □ ...this is just the beginning...



Copyright © Norman Sadeh, 2005-2010

Mobile Device Coupled with External Sensor



Source: http://www.apple.com/ipod/nike/

Copyright © Norman Sadeh, 2005-2010

Zipcar App: Mobile Device As Remote



Source: App Store

Copyright © Norman Sadeh, 2005-2010

Cell phones as Sensor Nets



So What Are the Things We Can't Do Yet?

What are the Missing Pieces?

- □ Higher degree of **context awareness**
- □ **Dialogues** with users
- Ability to discover & interact with different services
 - Not just services identified ahead of time
- Security & Privacy

New Revenue Sharing Models

A Valentine's Day Scenario



N. Sadeh, "M-Commerce: Technologies, Services and Business Models", Wiley 2002

Copyright © Norman Sadeh, 2005-2010

In Practice...

- The explosion in location-based services can be attributed to the availability of location APIs
 - Apple SDK, Android, Symbian, etc.
- Many apps are developed in 6-8 weeks
- Developers don't have the resources to develop an App for our Valentine's Day scenario unless ...
 - ...new layers of interoperability are introduced...

MyCampus

Copyright © Norman Sadeh, 2005-2010



- Campus as "everyday life microcosm"
- Enhance campus life through context-aware services accessible from mobile devices
- □ A growing collection of context-aware agents/applications that:
 - Users can acquire/subscribe to/invoke
 - Customize themselves through automated identification and access of relevant contextual resources

What are Semantic Web Technologies?

- Collection of languages (W3C's RDF/RDFS, OWL, etc.) to:
 - Define ontologies
 - Collection of concepts and relationships between these concepts in a given domain
 - e.g. Space, Calendar Activities, Access Devices, User Preferences, etc.
 - Facts and rules defined in relation to these ontologies
- Shared ontologies enable disparate applications to communicate with one another.
 - Content becomes machine understandable

Copyright © Norman Sadeh, 2005-2010

Personal Resource Ontology: An Example



Benefits

- Easy to re-use sources of contextual information across different applications
- Can adapt to resources available for different users at different points in time
- Can discover and interact with new services



Android Expects You to Agree Upfront



Apple Expects You ...



...to answer the same question 1000 times...

...with multi-tasking in OS4, they'll show you which app accessed your location in the past 24 hours...

...even if it's too late ...

We Need Something better

- Neither approach scales
- □ Neither approach is usable

In practice...

People have context-dependent preferences...



Green: Share Red: Don't

Copyright © Norman Sadeh, 2005-2010



Feedback Through Audit Logs



Evaluating the Usefulness of Auditing

Examining Users' Privacy Rules <u>at the end</u> of the study





Copyright © Norman Sadeh, 2005-2010

Likely to See a New Privacy Layer





... This New Privacy Layer

□ Will have to:

- Support rich, context-sensitive privacy preferences
- Be capable of supporting auditing and dialogue with users
- Be scalable
- In the second second

Concluding Remarks

- The App Store model addresses fundamental trust and usability issues
- Yet, for new context-aware and pervasive computing applications to emerge, the model will need to evolve
- □ ...Introducing **new layers of interoperability**:
 - For developers
 - Contextual Attributes, Privacy & Security
 - Support for smart dialogues (incl. some machine learning to incrementally build/refine user models)
 - For other partners
 - □ The cell phone is only one piece of the emerging ecosystem appliances & services
- I... and richer set of revenue sharing models

Copyright © Norman Sadeh, 2005-2010

Expect....

- **Many more applications** that:
 - Take advantage of an increasingly rich ecosystem
 - Increasingly provide for more intelligent interactions with users
 - ...Eventually turning into personal assistants that help users with increasingly complex tasks
- This transformation will take place over many years...

Copyright © Norman Sadeh, 2005-2010

Q&A



Relevant Websites

- www.mcom.cs.cmu.edu/
- □ <u>www.locaccino.com</u>
- http://mcom.cs.cmu.edu/user-controllablesecurity-and-privacy/
- □ <u>www.zipano.com</u>

Relevant Publications

- Norman Sadeh, "M-Commerce: Technologies, Services and Business Models", Wiley 2002
- Norman Sadeh, Jason Hong, Lorrie Cranor, Ian Fette, Patrick Kelley, Madhu Prabaker, and Jinghai Rao. <u>Understanding and Capturing People's Privacy</u> Policies in a Mobile Social Networking Application Journal of Personal and Ubiquitous Computing 2009.
- J. Tsai, P.G.Kelley, L.F.Cranor and N.M. Sadeh, "Location Sharing Technologies: <u>Privacy Risks and Controls</u>", to appear in "I/S: A Journal of Law and Policy for the Information Society", 2010.
- Ramprasad Ravichandran, Michael Benisch, Patrick Gage Kelley, and Norman M. Sadeh. Capturing Social Networking Privacy Preferences: Can Default Policies Help Alleviate Tradeoffs between Expressiveness and User Burden? PETS '09.
- Janice Tsai, Patrick Kelley, Paul Hankes Drielsma, Lorrie Cranor, Jason Hong, and Norman Sadeh. <u>Who's Viewed You? The Impact of Feedback in a Mobile-location System.</u> *CHI '09*.
- Patrick Kelley, Paul Hankes Drielsma, Norman Sadeh, Lorrie Cranor. User Controllable Learning of Security and Privacy Policies. AlSec 2008.
- Michael Benisch, Patrick Gage Kelley, Norman Sadeh, Lorrie Faith Cranor, <u>Capturing Location-Privacy Preferences: Quantifying Accuracy and User-Burden Tradeoffs.</u> CMU-ISR Tech Report 10-105, March 2010
- Norman Sadeh, Fabien Gandon and Oh Buyng Kwon. <u>Ambient Intelligence:</u> <u>The MyCampus Experience</u> School of Computer Science, Carnegie Mellon University, Technical Report CMU-ISRI-05-123, July 2005.

Copyright © Norman Sadeh, 2005-2010

Acknowledgements

- Research funded by the US National Science Foundation, the US Army Research Office, CMU CyLab, Microsoft, Google, Nokia, FranceTelecom, and ICTI
- The User-Controllable Privacy Platform on top of which Locaccino is built is now commercialized by Zipano Technologies.