

# Location tracking

Lorrie Faith Cranor

October 14, 2014

8-533 / 8-733 / 19-608 / 95-818:  
*Privacy Policy, Law, and Technology*

Carnegie  
Mellon  
University  
CyLab

**isr** institute for  
SOFTWARE  
RESEARCH

Engineering &  
Public Policy



# Today's agenda

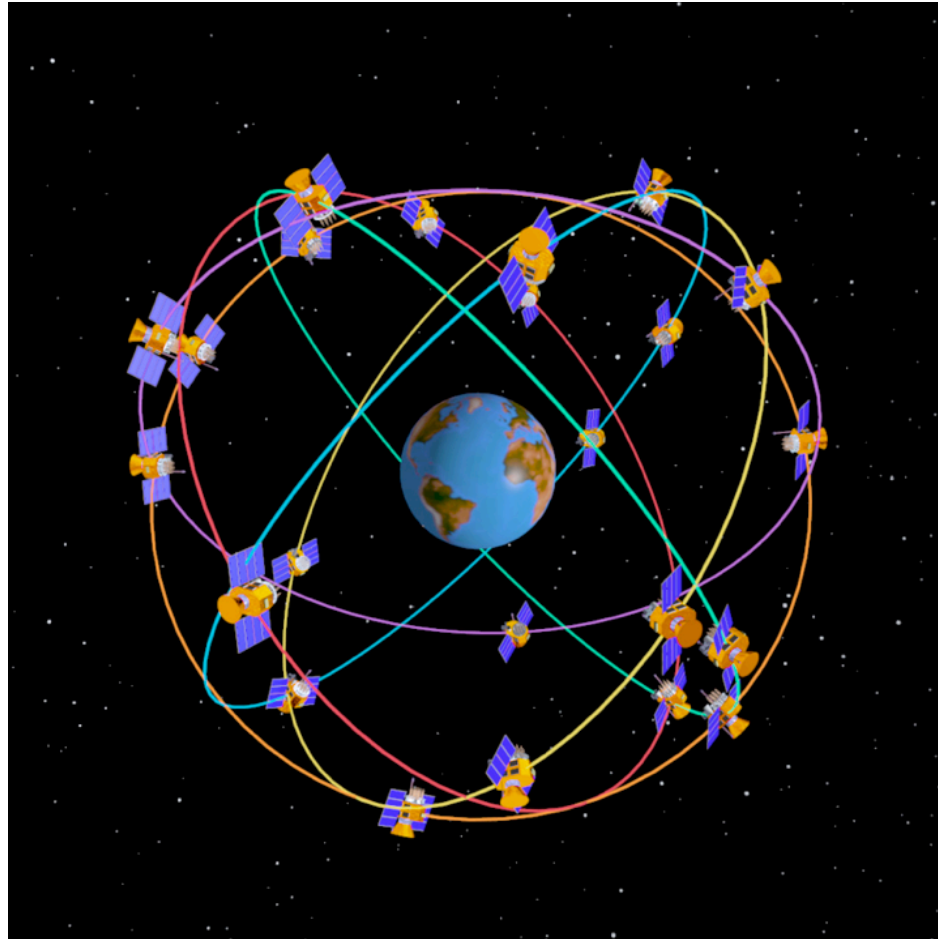
- Quiz
- Questions/comments about the readings
- Locating Technologies
- Location-Sharing Applications and Privacy Controls
- How private can location data be?
- Protecting location privacy and privacy controls

# By the end of class you will be able to:

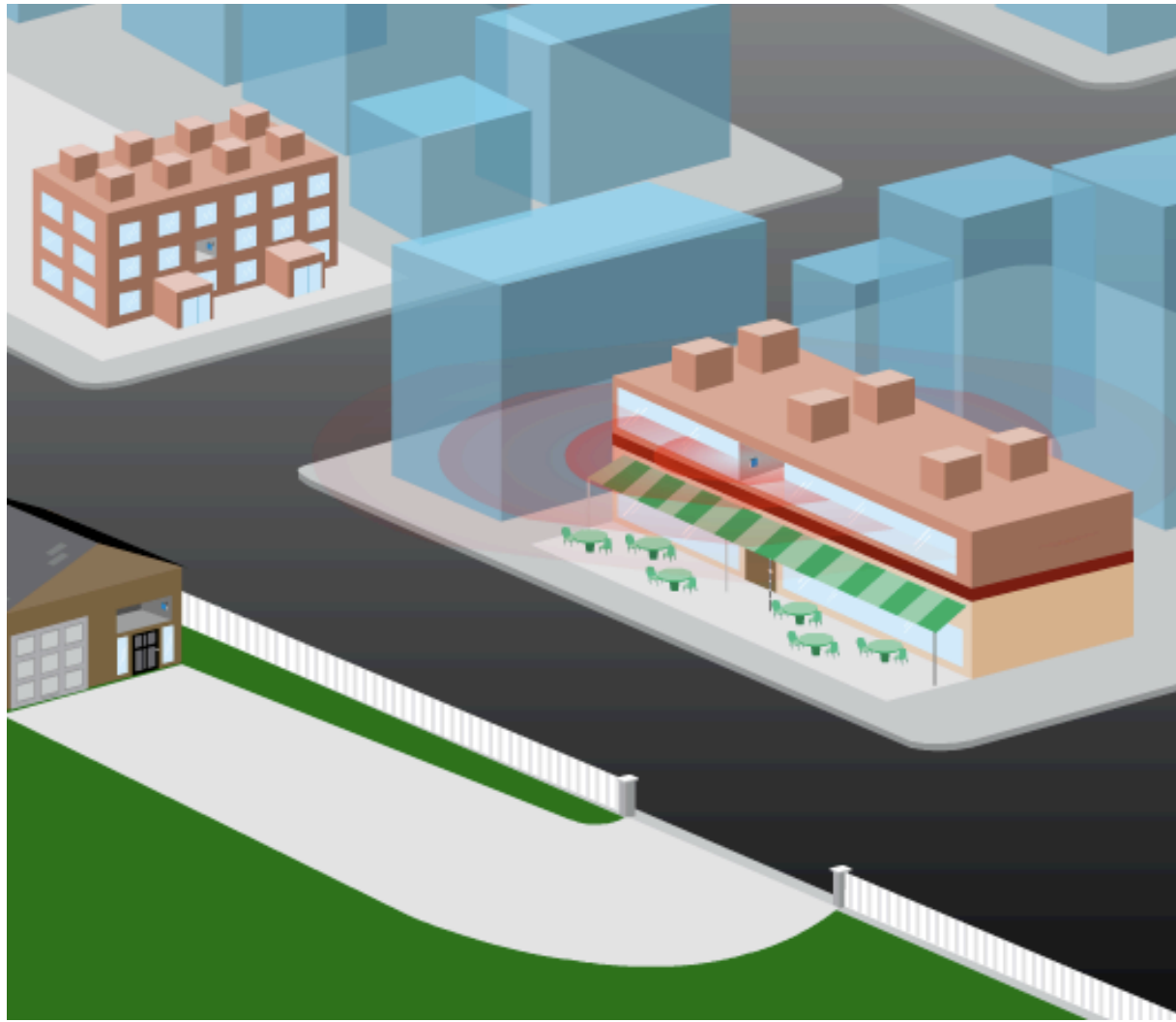
- Understand how location tracking works
- Understand the difficulties in protecting location privacy and some strategies that can help
- Understand how privacy controls can help

# Locating Technologies

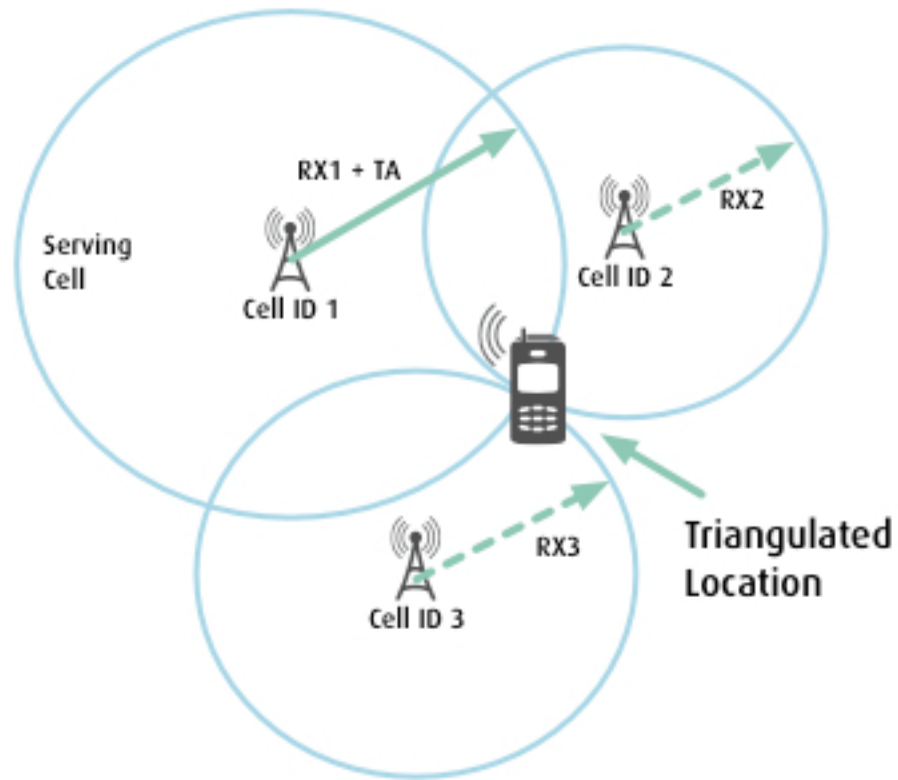
# Global Positioning System



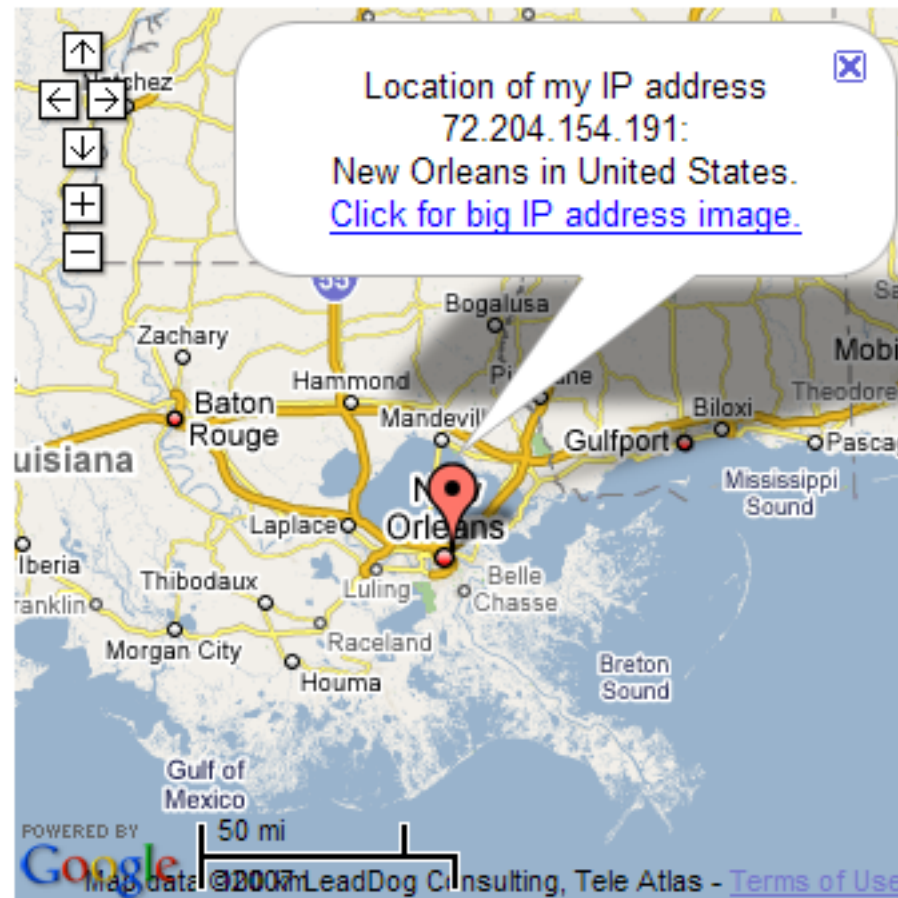
# WiFi Positioning



# Cellular Triangulation



# IP Location






# Location-Sharing Applications and Privacy Controls


# Privacy features

- Most current location sharing services allow sharing to be either on or off, per person
- Many have a “make me invisible feature” (e.g. Loopt and Brightkite)
- Some have the ability to limit by location granularity (e.g. Google Latitude and FireEagle)
- Commercial services don’t have fine-grained privacy controls or ability to see who is tracking your location

# Loopt privacy settings







**Janice**  
Edit Profile



Hey! Click here to update and share what you're up to!  
[Your shared location will be here](#)

[Search](#) | [Settings](#) | [Logout](#)

[Home](#) | [Friends](#) | [Journal](#) | [Messages](#)

**Settings**  
**Privacy Settings**  
Text & Email Alerts  
Loopt Link  
 Twitter  
 Facebook  
 Journal Widget  
 Journal Feed (RSS)  
**My Account**  
Edit My Profile  
Change Password  
Delete My Account

## Privacy Settings

### Profile Privacy

Choose who can see your profile information. *Your friends can always see your entire profile.*

**Entire Profile:** ☐ My Friends and Their Friends  
☒ My Friends Only

### Location Privacy

Choose who can see your location with the settings below.

**Who can find me?** ☐ Nobody  
☒ Some Friends

I want to *block* my location from...

# Loopt privacy settings

The screenshot shows the Loopt user interface. At the top, there's a blue header bar with the Loopt logo on the left, a user profile for 'Janice' with an 'Edit Profile' link, and navigation links for 'Search', 'Settings', and 'Logout' on the right. Below the header, a message box says 'Hey! Click here to update and share what you're up to!' with a link 'Your shared location will be here'. Navigation links 'Home', 'Friends', 'Journal', and 'Messages' are also present.

On the left side, there's a sidebar menu with categories: 'Settings' (containing 'Privacy Settings', 'Text & Email Alerts', 'Loopt Link', 'Twitter', 'Facebook', 'Journal Widget', and 'Journal Feed (RSS)'), and 'My Account' (containing 'Edit My Profile', 'Change Password', and 'Delete My Account').

The main content area is titled 'Privacy Settings'. Under the 'Profile Privacy' section, it says 'Choose who can see your profile information. Your friends can always see your entire profile.' Below this, the 'Location Privacy' section is highlighted with a red border. It contains the heading 'Location Privacy', followed by the instruction 'Choose who can see your location with the settings below.' and a question 'Who can find me?' with two radio button options: 'Nobody' and 'Some Friends'. The 'Some Friends' option is selected. At the bottom of this section, there's a partially visible link 'I want to block my location from...'.

Search | Settings | Logout

Janice  
Edit Profile

Hey! Click here to update and share what you're up to!  
✈ Your shared location will be here

Home | Friends | Journal | Messages

Settings

Privacy Settings

Text & Email Alerts

Loopt Link

Twitter

Facebook

Journal Widget

Journal Feed (RSS)

My Account

Edit My Profile

Change Password

Delete My Account

Privacy Settings

Profile Privacy

Choose who can see your profile information. Your friends can always see your entire profile.

Location Privacy

Choose who can see your location with the settings below.

Who can find me?

☐ Nobody

☒ Some Friends

I want to block my location from...


# Google Latitude privacy settings

Google Latitude Edit Delete Share


[Friends](#) [Add friends](#) [Privacy](#)

street, city, state, zip Set location Help


[Your location is manually set](#)




[Janice Tsai - view profile »](#)  
Pittsburgh, PA 0 min ago  
[Set status here](#)




[Nels Beckman - view profile »](#)  
Pittsburgh, PA 9 mins ago  
<http://www.mustachepeggh.com/>



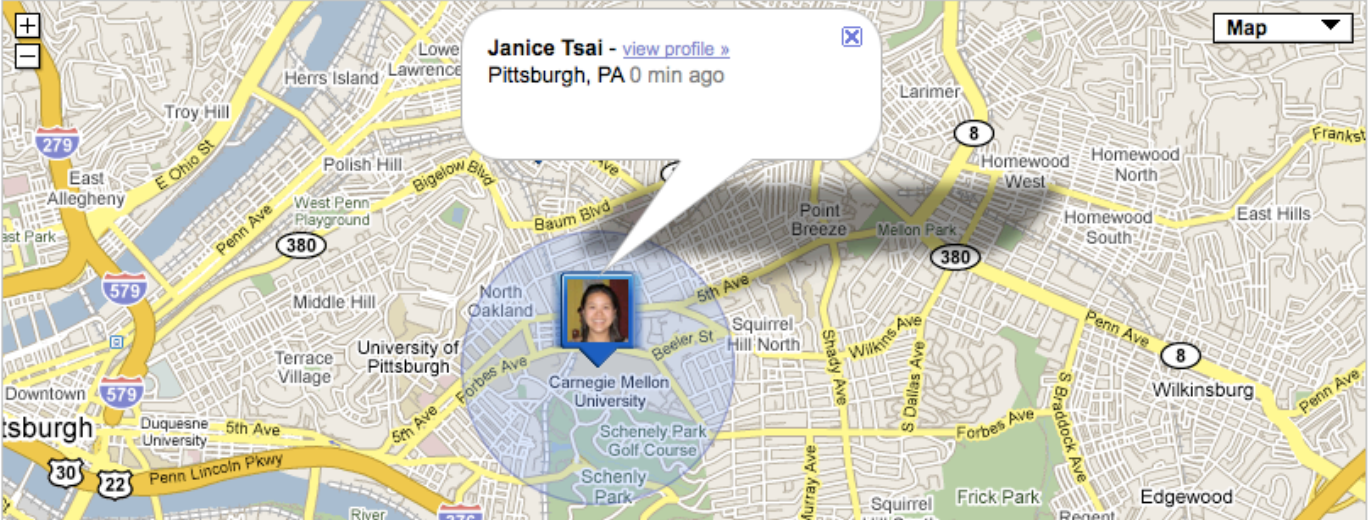
[Paul Hanks Drielsma - view profile »](#)  
French Polynesia 41 days ago  
I wish!



[Aaron W. Dobbs - view profile »](#)  
Unknown Location  
Unproductively productivist

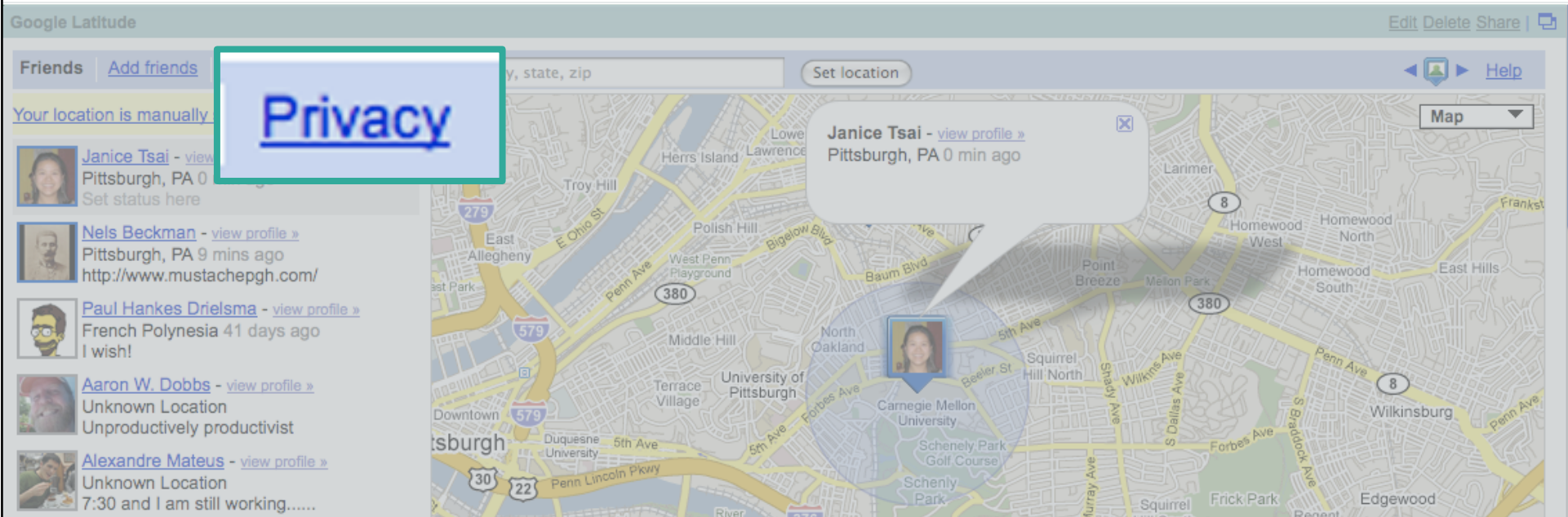


[Alexandre Mateus - view profile »](#)  
Unknown Location  
7:30 and I am still working.....



The map displays a view of Pittsburgh, PA, with a blue location pin for Janice Tsai. A callout bubble above the pin reads: "Janice Tsai - [view profile »](#)  
Pittsburgh, PA 0 min ago". The map includes labels for various neighborhoods and landmarks such as Troy Hill, Herrs Island, University of Pittsburgh, Carnegie Mellon University, and Schenley Park. Major roads like I-279, I-579, and I-30 are also visible.

# Google Latitude privacy settings





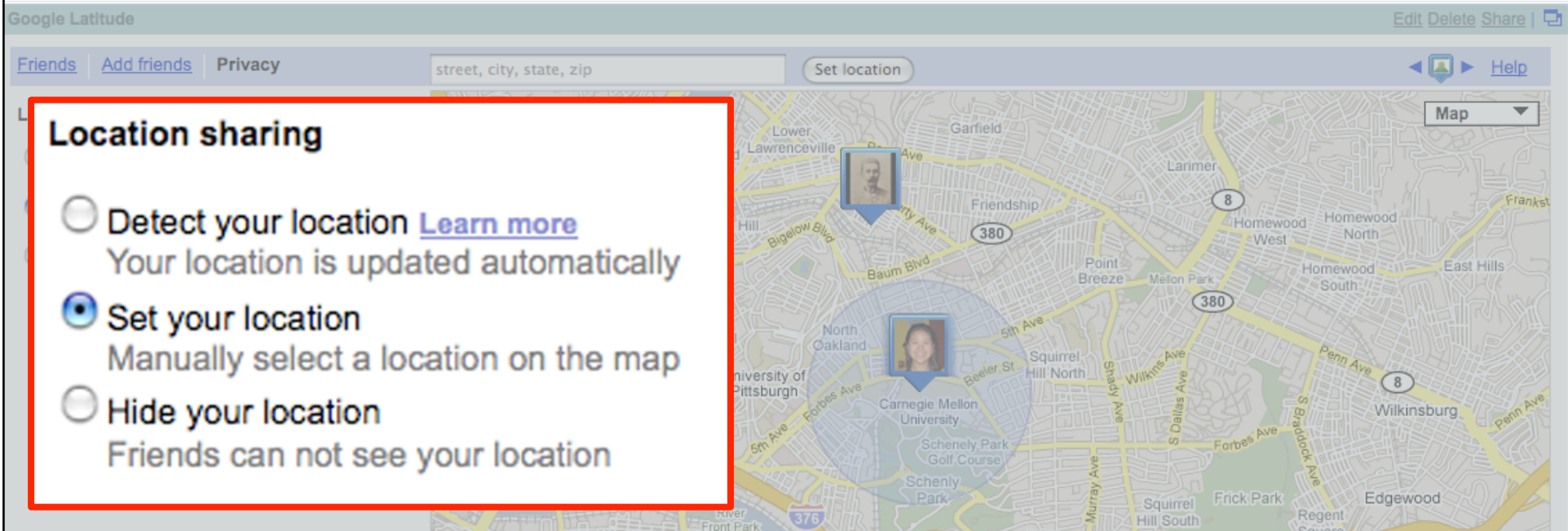
# Google Latitude privacy settings

Google Latitude Edit Delete Share |

[Friends](#) [Add friends](#) [Privacy](#)   Map [Help](#)

### Location sharing

- ☐ **Detect your location** [Learn more](#)  
Your location is updated automatically
- ☒ **Set your location**  
Manually select a location on the map
- ☐ **Hide your location**  
Friends can not see your location



# Location-Sharing Applications

- Reviewed 89 Applications in August 2009
  - Date of Launch
  - Privacy Policy
  - Privacy Controls
  - Immediately Accessible Privacy Settings



# Privacy Overview

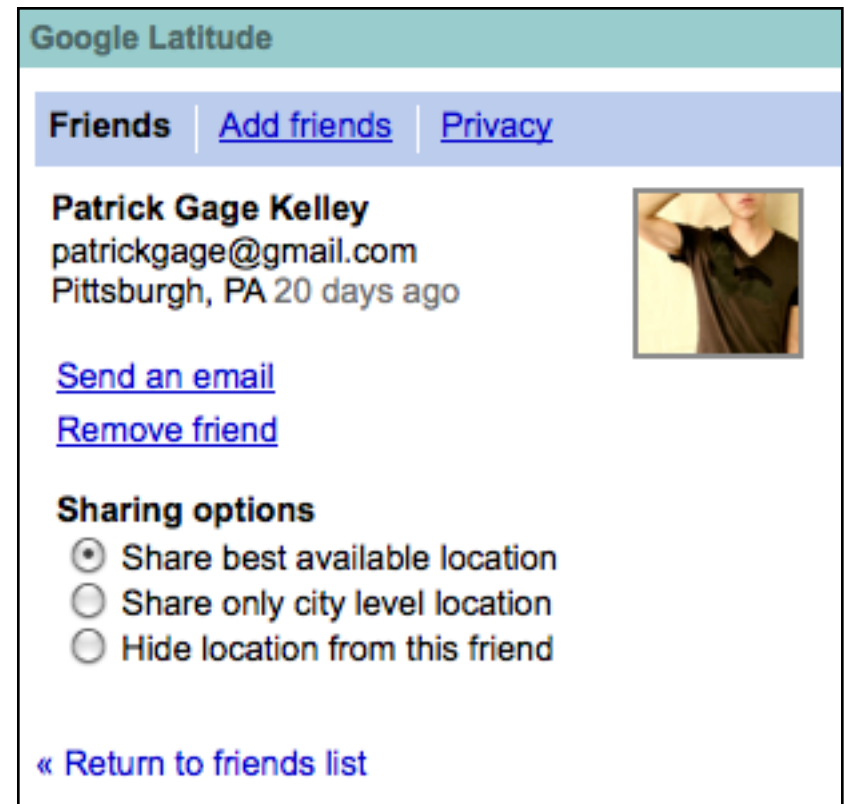
- Types of Applications
  - Open: Requested by anyone (52)
  - Closed: Requested by friends only (29)

Category	Yes	No	Unknown	Not Applicable
Privacy Policy	66%	34%	-	-
Privacy Controls	76%	17%	1%	6%
Accessible Privacy Settings	17%	75%	2%	6%

# Types of Restrictions

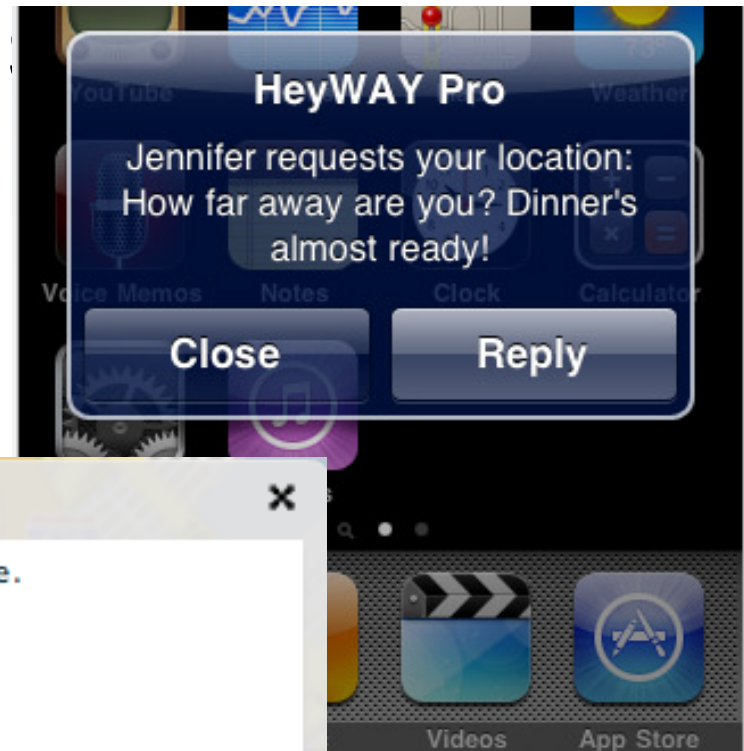
- Friends Only (49.4%)
- Granularity (11.2%)
- Blacklist (15.7%)
- Invisible (33.7%)

% of applications



# Types of Restriction

- Per-Request (2.25%)
- Time-Expiring (2.25%)



**Create TrackMe** [X]

Please specify a message, destination and duration for this TrackMe.

Whoever you send this TrackMe to will be able to track you for this amount of time.

The message and destination are optional.

Message	<input type="text" value="Pittsburgh, PA"/>
Destination Address	<input type="text" value="5000 Forbes Ave. Pittsburgh, PA"/>
Duration	<input type="text" value="15 Minutes"/> ▼

**OK** **Cancel**

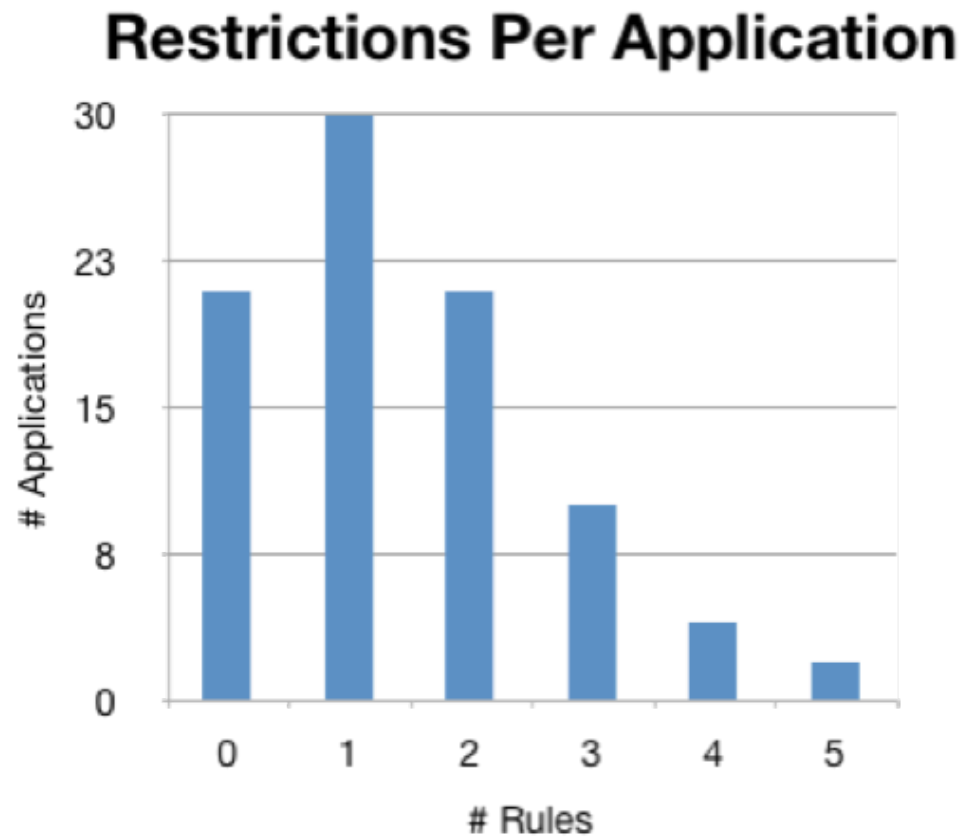
# Most Frequent Controls

- Friends Only (49.4%)
- Invisible (33.7%)

% of applications

# Privacy Controls

- Frequency of Restrictions



# Best ways to mitigate the greatest expected risks

- Blacklist (16%)
- Granularity (12%)
- Group-based rules (12%)
- Location-based rules (1%)
- Time-based rules (1%)

% of applications

# Recommendations for developers

- Need for more expressive privacy controls in most applications
- Providing expressive controls could reduce concerns
- Developers must balance expressiveness and user burden

# Recommendations for users

- Understand why you want to use location-sharing application (social, coordination, etc.)
- Find application well-suited to your needs
- Configure privacy controls
- Avoid public posting of your location with your real name



# LOCACCINO

<http://locaccino.org>

# LOCACCINO

[about](#)[science](#)[help](#)[contact](#)

## A User-Controllable Location-Sharing Tool

Welcome to Locaccino. Our location-centered social application allows you to share your location with your friends. Whether they are checking to see if your flight landed safely, planning a Friday night outing, or just wondering if you are in the office to grab coffee, Locaccino is there to help you share!

[Start Locaccino](#)

### *Privacy Controls*

Locaccino is the only location-sharing system that gives you precision control over who can see your location. While most location-based systems only allow you to list which of your contacts should or shouldn't be able to see your location, our privacy settings allow you to create rules as simple or complex as you want them to be!

*"...we all should have the right to draw the curtain when we want."*

*—Stephen Baker*

# LOCACCINO

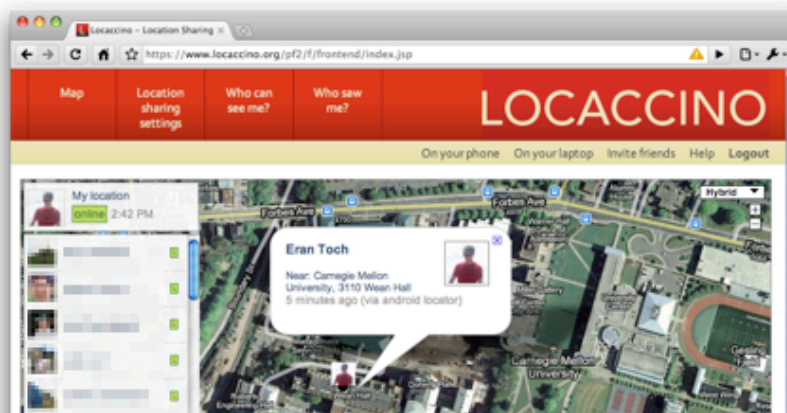
## Locaccino is a location sharing application that lets you:

- > Securely share your location with selected friends and family in your Facebook network
- > Specify the people, places and times when you want to share your location. With Locaccino, allowing your co-workers to see your location only from 8AM - 5PM is a snap
- > See a complete history of people who requested your location
- > No need to check-in to your favorite spots! Locaccino gives you continuous and live updating of your location on your smartphone or on your laptop computer

A blue rectangular button with a white Facebook 'f' logo on the left and the text 'Facebook Login' in white on the right. The button is circled in red.

Click the Facebook login button to join or login

No login button? [Click here](#)



Map

Location  
sharing  
settingsWho can  
see me?Who saw  
me?

LOCACCINO

On your phone On your laptop Invite friends Help Logout

The screenshot shows the Locaccino web application interface. On the left, a sidebar lists nearby friends with their profile pictures and names: My location (online 7:01 PM), Jason Hong, Ben Streeter, Brian LaMacchia, Chuck Cranor, David Pierpont, Dena Tsamitis, Earl Crane, Eran Toch, and Fred Dougils. A red circle highlights the 'Nearby friends' button at the bottom of the list. The main area displays a map of Pittsburgh. A red circle highlights a location popup for Lorrie Cranor, which includes her profile picture, name, and text stating 'Location is approximated 25 seconds ago (via android locator)' and a 'Share on Facebook' button. The map shows streets like Forbes Ave, Schenley Dr, and various parks and landmarks.

[Map](#)[Location  
sharing  
settings](#)[Who can  
see me?](#)[Who saw  
me?](#)

# LOCACCINO

[On your phone](#) [On your laptop](#) [Invite friends](#) [Help](#) [Logout](#)

## Location sharing rules

### CUPS students

CUPS students (**Kursat, Joanna** and 8 others) can see your location **wherever you are**, on **weekdays** between **8:00 am** and **7:00 pm**

[Edit](#)[✕ Delete](#)

### Chuck

Chuck can see your location **wherever you are**, **at all times**

[Edit](#)[✕ Delete](#)

### Locaccino team

Locaccino team (**Jason, Paul** and 11 others) can see your location **wherever you are**, on **weekdays** between **7:00 am** and **6:00 pm**

[Edit](#)[✕ Delete](#)

### colleagues

Faculty (**David, Erica** and 26 others) can see your location **wherever you are**, on **weekdays** between **8:00 am** and **6:00 pm**

[Edit](#)[✕ Delete](#)

### on campus

All your friends can see your location when you are at **Some place**, **at all times**

[Edit](#)[✕ Delete](#)

### seattle

Seattle friends (**Stuart, Helen** and 2 others) can see your location when you are at **seattle**, **at all times**

[Edit](#)[✕ Delete](#)



**Rule Editing**

Cancel

Save changes

Rule name

**Who** Who can see my location?

You currently do not share your location with any friends

Add friends

**Where** Where can they see my location?

e.g. my friends can see my location only when I am at the "Carnegie Mellon University campus"

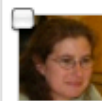
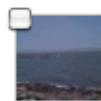
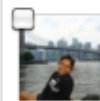
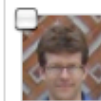
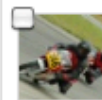
☒ I can be located in all locations ☐ I can be located in these locations...**When** When can they see my location?☒ I can be located all the time ☐ I can be located part of the time...

Cancel

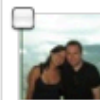
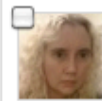
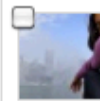
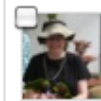
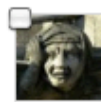
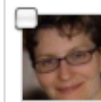
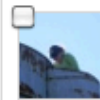
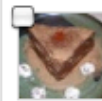
Save changes

**Add all friends**☐ All my friends**Add Facebook Networks**☐ Carnegie Mellon**Add Locaccino Friend Lists**☒ CUPS students (10) [edit](#)☐ Locaccino team (13) [edit](#)☐ Extended family (9) [edit](#)☐ Locaccino demo (3) [edit](#)☐ Seattle friends (4) [edit](#)☐ Faculty (28) [edit](#)[+ New Friend List](#)**Add individual friends**

Search

Abigail  
DakenAbigale  
MarcusAditi  
PendharkaAdrian  
Perrig

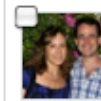
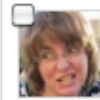
Ak Aka

Aleecia  
M.  
McDonaldAlex  
BergAlex  
FowlerAlma  
WhittenAmber  
Hallock  
AckermanAmrita  
JainAmy  
BruckmanAmy  
Schlagel  
FedermanAndrea  
MatwyshynAnind  
DeyAnna  
GilbertAnna  
Maria  
BertaAnne  
Antonowicz  
TothAnnie  
AntónAnupam  
Datta

Ari Juels

Ari  
Schwartz

Arry Shin

Avi  
RubinBarry  
SteinhardtBekah  
HurlbertBeki  
GrinterBen  
Streeter[Cancel](#)[Update Rule](#)

## Rule Editing

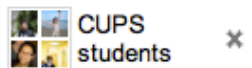
Cancel

Save changes

Rule name 

## Who Who can see my location?

Add friends



## Where Where can they see my location?

e.g. my friends can see my location only when I am at the "Carnegie Mellon University campus"

☒ I can be located in all locations ☐ I can be located in these locations...

## When When can they see my location?

☐ I can be located all the time ☒ I can be located part of the time...☐ Sun ☒ Mon ☒ Tue ☒ Wed ☒ Thu ☒ Fri ☐ SatFrom:  To:  ☐ All day

Cancel

Save changes



## Rule Editing

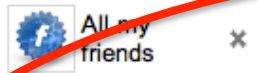
Cancel

Save changes

Rule name on campus

## Who Who can see my location?

Add friends

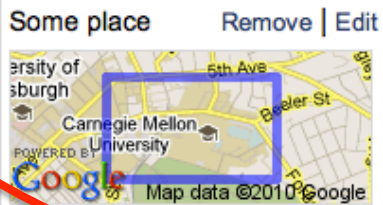


## Where Where can they see my location?

e.g. my friends can see my location only when I am at the "Carnegie Mellon University campus"

☐ I can be located in all locations ☒ I can be located in these locations...

Add Location



## When When can they see my location?

☒ I can be located all the time ☐ I can be located part of the time...

Cancel

Save changes

## Rule Editing

Cancel

Save

Location name: 

Rule name

 Find address My Location

Who Who can

Add friends



All my friends

Where Where

e.g. my friends

☐ I can be located

Add Location

Some place

University of

Carnegie Mellon

University

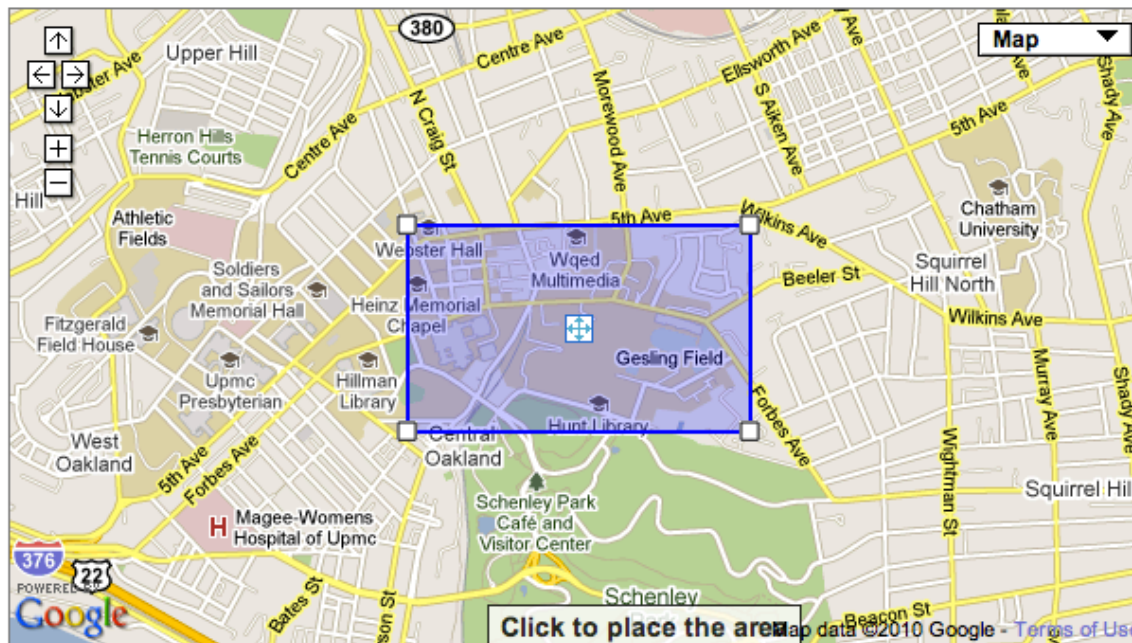
8:00 a

When When

☒ I can be located all the time☐ I can be located part of the time...

Cancel

Save changes



Cancel

Save

[Map](#)[Location  
sharing  
settings](#)[Who can  
see me?](#)[Who saw  
me?](#)

# LOCACCINO

[On your phone](#) [On your laptop](#) [Invite friends](#) [Help](#) [Logout](#)[Change privacy settings](#)

## Friends who **can** locate me right now



Chuck Cranor



Lorrie Cranor

## Friends who **cannot** locate me right now



Ben Streeter



Joshua Sunshine



Hazel Mary



Ziv Zipano



Greg Norcie



Linda Francona



Linda Little



Earl Crane



Mike Cronin



David Pierpont



Dena Tsamitis



Jules Polonetsky



Norman Sadeh



Serge Egelman



Eran Toch



Seth Carlson



Sally Yanagihara



Janice Tsai



Megan Spence



Kursat Ozenc

Map




Location  
sharing  
settingsWho can  
see me?Who saw  
me?





























LOCACCINO

On your phone On your laptop Invite friends Help Logout

Show records from:

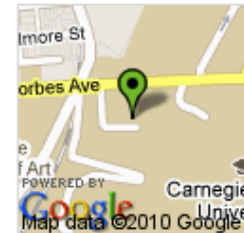
Last 7 days

**Real** Your friend used Locaccino to request your location.**What-if** Your friend did not request or see your location. This "what-if" request is intended to help you understand what your current settings allow.**Allow** The request was allowed by your settings.**Deny** The request was denied by your settings.**Offline** You were offline at the time of the request.**Hidden** You were in invisible mode at the time of the request. Select this if you are **dissatisfied** with the outcome, for example when you wish Locaccino didn't share your location. Select this if you are **satisfied** with the outcome. Select this if you were not at this location at the given time.

Who and When		Type	Where was I?	Outcome	Feedback
	<b>Kami Vaniea</b> Fri, Oct 15, 6:49 PM	<b>Real</b>	(See map)	<b>Allow</b>	  
	<b>Janice Tsai</b> Fri, Oct 15, 5:13 PM	<b>What-if</b>	Carnegie Mellon University, Resnik House (See map)	<b>Allow</b>	  
	<b>Norman Sadeh</b> Fri, Oct 15, 8:42 AM	<b>Real</b>	Carnegie Mellon University, Smith Hall (See map)	<b>Allow</b>	  
	<b>Linda Little</b> Fri, Oct 15, 7:05 AM	<b>What-if</b>	5432 Northumberland St, Pittsburgh, PA 15217 (See map)	<b>Deny</b>	  
	<b>Wang Kai Jimmy</b> Fri, Oct 15, 7:05 AM	<b>What-if</b>	5432 Northumberland St, Pittsburgh, PA 15217 (See map)	<b>Deny</b>	  
	<b>Norman Sadeh</b> Fri, Oct 15, 6:31 AM	<b>What-if</b>	5439 Northumberland St, Pittsburgh, PA 15217 (See map)	<b>Deny</b>	  
	<b>Patrick Kelley</b>	<b>What-if</b>	5424 Northumberland St, Pittsburgh, PA	<b>Deny</b>	  

Map

**Norman** requested your location at **8:39 AM** on **Friday** when you were at **Carnegie Mellon University, Smith Hall**. Your location sharing settings **allowed** the request.



You indicated that you were happy with this.

Show records from:

Last 7 days

Why did you want Norman to see your location?

- > I want Norman to know where to meet me.
- > I want Norman to know that I am in a safe location.
- > I want Norman to know the locations I go to and activities I do.
- > This is not a sensitive location. I do not mind sharing it with Norman.
- > I don't mind if Norman knows where I am at this time of day.
- > There is no particular reason, I just didn't mind sharing my location with Norman.
- > None of these. Please answer below:

Submit

- > Close without saving feedback.

INO

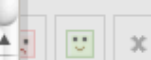
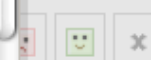
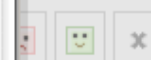
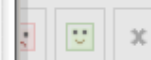
Help Logout

satisfied with the  
you wish Locaccino

isified with the outcome.

ot at this location at the

Feedback



Patrick Kelley

5424 Northumberland St, Pittsburgh, PA



Locaccino – Location Sharing

◀ ▶

🏠

A A

+

📄

https://www.locaccino.org/pf2/f/frontend/download.jsp?page=download

↻

🔍 Google

Map

Location sharing settings

Who can see me?

Who saw me?

LOCACCINO

On your phone

On your laptop

Invite friends

Help

Logout

Step 1 Downloading the Locator

Download Locaccino for your laptop computer:

Mac OS X | Windows Vista / Windows 7 | Windows XP

Step 1.5 Installing the Locator

- Double click on the Locaccino Locator installer to start the installation.
- Locaccino requires your computer password in order to complete the installation process. We do not store or use this password for anything else.

Locaccino\_macos\_

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▼ DEVICES

Macintosh HD

Locaccino\_macos\_ ▲

▶ SHARED

▼ PLACES

Desktop

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Applications

📁

Locaccino Locator Installer

📁

Locaccino\_macos\_

1 item, Zero KB available

Step 2 After the installation

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Map

Location  
sharing  
settingsWho can  
see me?Who saw  
me?

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Phone Username and password

Get locaccino client for your phone

Choose a user name and password for your mobile Locaccino client. You can always change it later in this page.

Username: Password: 

For optimum performance and battery life, we recommend that you enable wi-fi on your phone.

Locaccino is available for Symbian and Android phones. First find Locaccino by following the instructions below, and then use your phone username and password to login to Locaccino.

### Android phones

Search for 'locaccino' on the [Android Market](#).

Get additional instructions for [Locaccino on Android](#).



### Symbian phones

Search for 'locaccino' on the [OVI store](#).

Get additional instructions for [Locaccino on Symbian](#).



# LOCACCINO

<http://locaccino.org>



# Limits on anonymizing location data

- Why is it difficult to anonymize location data?
- How unique is location data?

# Protecting location privacy

- What strategies can we use to protect privacy while gaining utility from location data?
  - Monitoring highway traffic flow
  - Find the nearest X
  - Friend finder

# Group discussion on location privacy controls

- When would you find it useful to share your location with an app, website, or friend?
- When would you not want to share your location?
- Specify a set of rules for sharing your location
  - What attributes are the rules based on?
  - How many rules do you need?



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