High Performance Multimedia Tools for Application Sharing, Measuring Capture-to-display Latency, and User Created Services

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PhD Thesis Defense
July 12, 2011

Outline

BASS
Application Sharing System

Performance of Video Chat Applications under Congestion

vDelay
A Tool to Measure Capture-to-Display Latency and frame rate

SECE
Sense Everything, Control Everything

Background information on Internet speeds

- According to the Federal Communication Commission (FCC) report*,
  - at mid-year **2010**,
  - **63%** of reportable connections were slower than **768 kbps** in the upstream direction,
  - 18% were at least 768 kb/s in the upstream direction but slower than 1.5 Mb/s, and
  - 19% were at least 1.5 Mb/s in the upstream direction.

- Sharing the limited uplink with
  - other applications such as BitTorrent
    - running on the same computer or
    - on the other users' computers (sharing the same connection)
  - makes things a lot harder.

*http://transition.fcc.gov/Daily_Releases/Daily_Business/2011/db0520/DOC-305296A1.pdf

BASS Application Sharing System

Omer Boyaci, and Henning Schulzrinne

[1] BASS Application Sharing System
Omer Boyaci, Henning Schulzrinne.
International Symposium on Multimedia (ISM2008), December, 2008, Berkeley, CA
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[3] Application and Desktop Sharing
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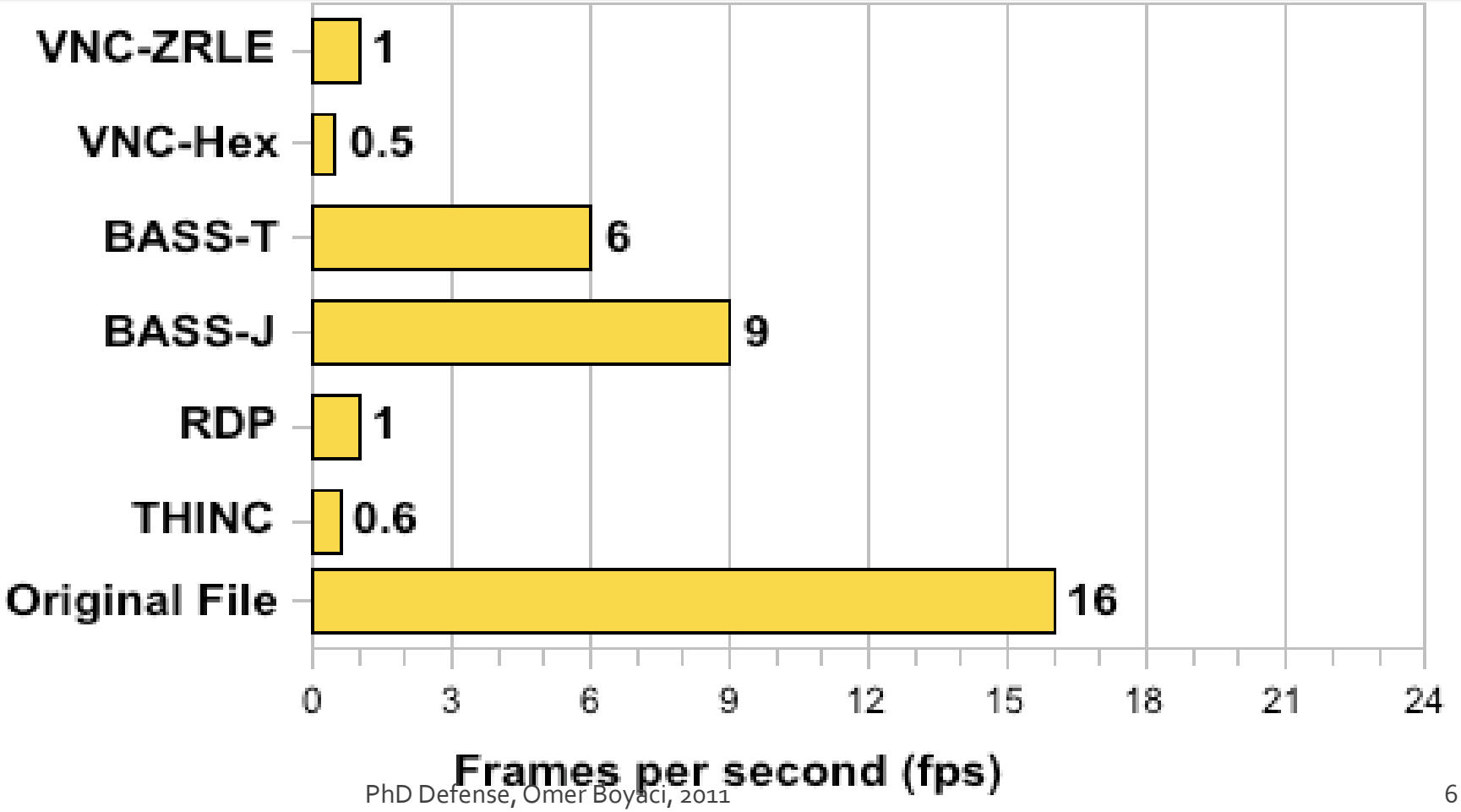
ACM CoNEXT 2007, student workshop, December, 2007, New york, NY

BASS Application Sharing System

- True application sharing (improves privacy and security)
- Supports multiple users
  - Reliable Multicast
  - Participants with different bandwidths
  - Floor Control
- Multimedia Support
  - Flash animations and videos

BASS Application Sharing System

Performance results for video (3 Mb/s bandwidth)



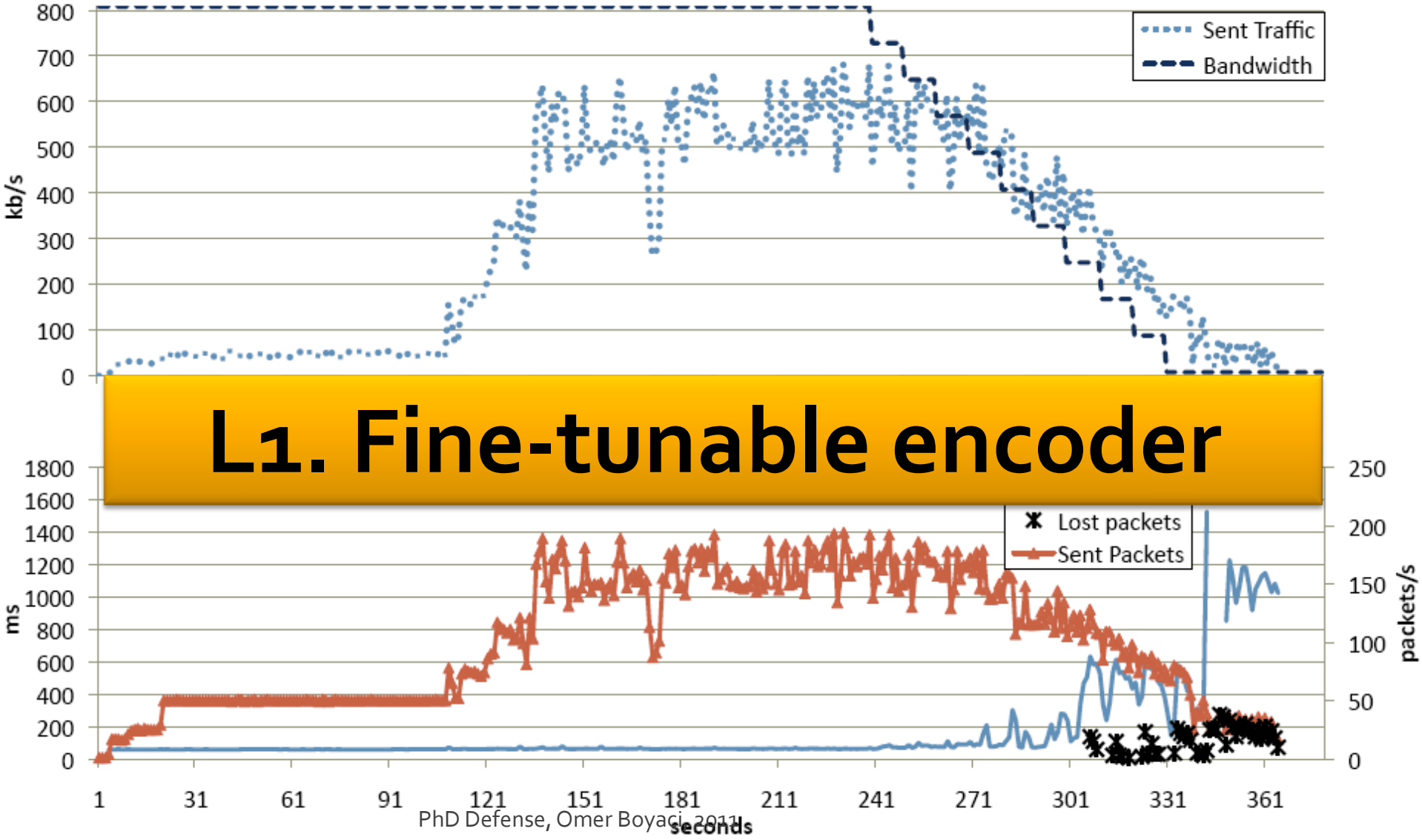
Performance of video chat applications under congestion

Omer Boyaci, Andrea Forte and Henning Schulzrinne

[4] Performance of video chat applications under congestion
Omer Boyaci, Andrea Forte, Henning Schulzrinne
International Symposium on Multimedia, short paper, December, 2009, San Diego, CA

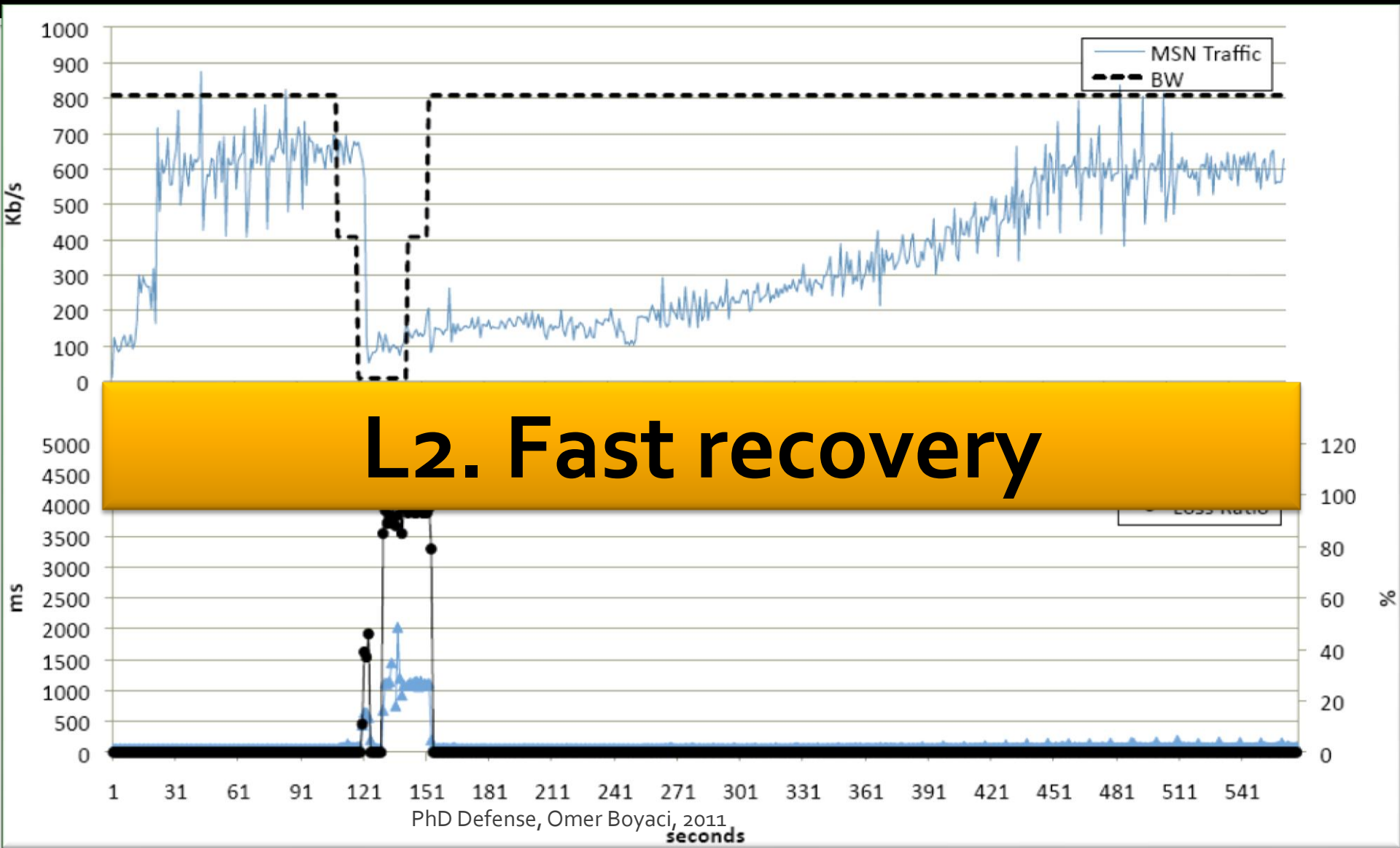
Experiment 1. Step 10sec10kbit

Skype



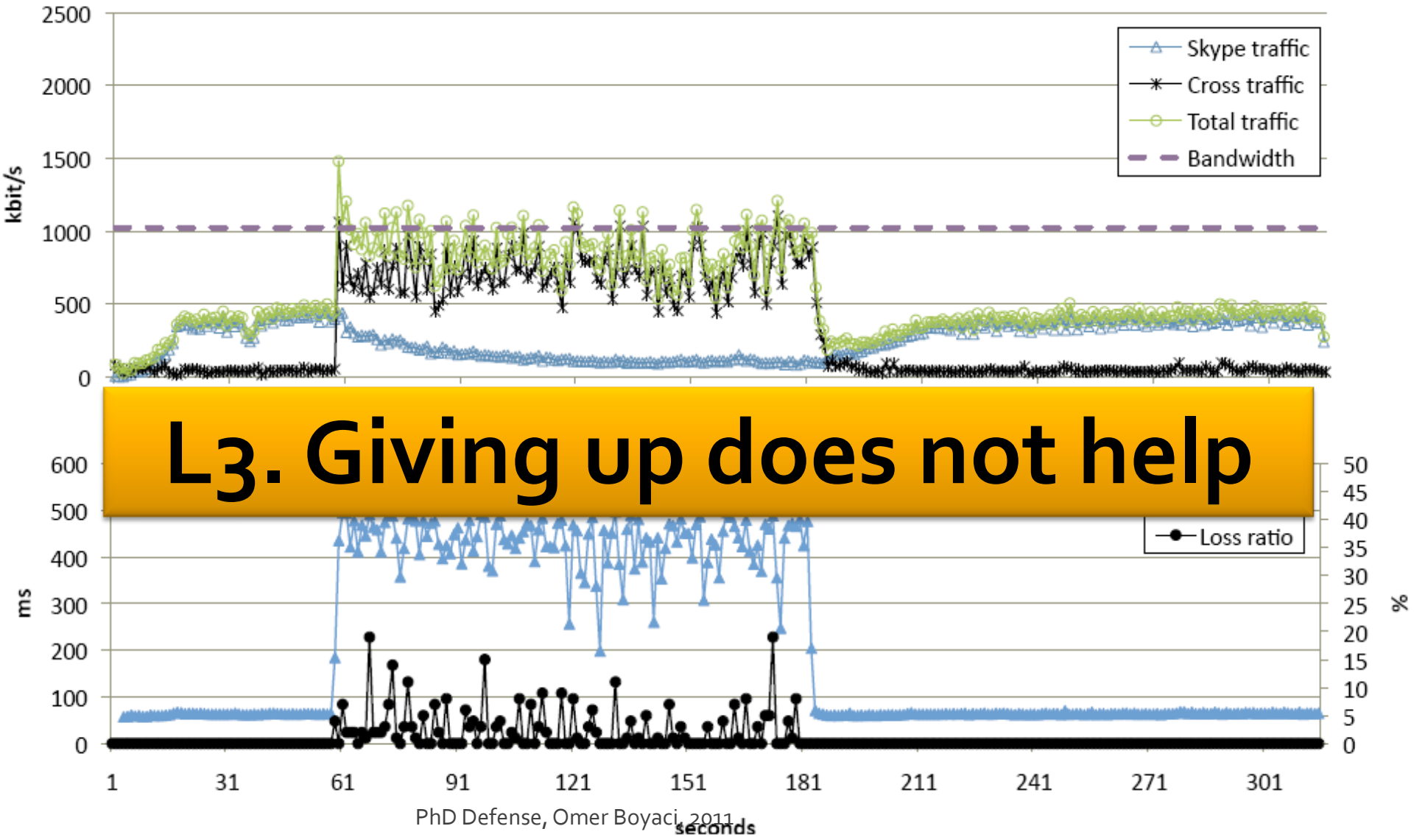
Experiment 2. Step 10sec50kbit

Live



L2. Fast recovery

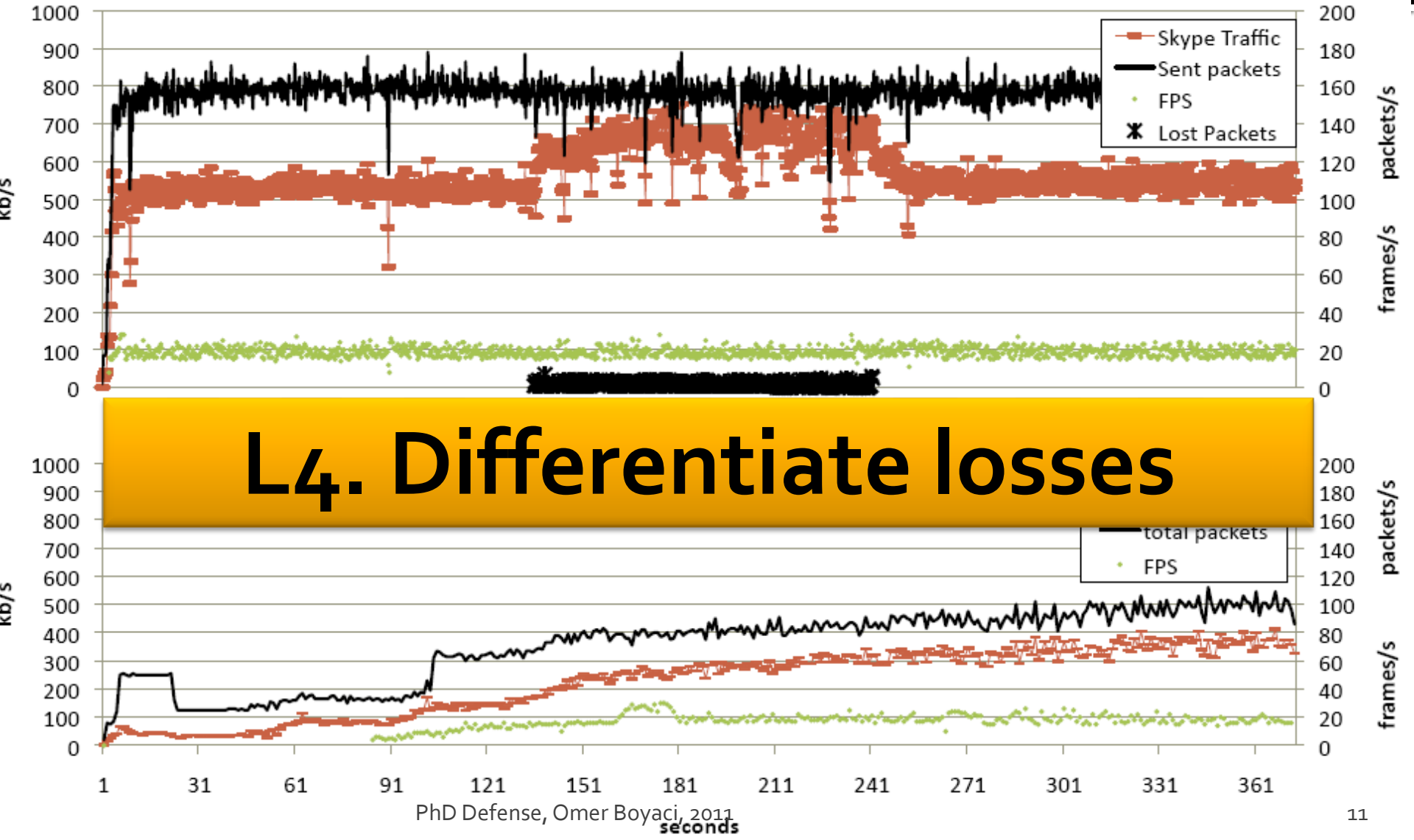
Experiment 4. Bittorrent Skype



L3. Giving up does not help

Experiment 5. Random Loss

Skype



L4. Differentiate losses

vDelay: A tool to measure Capture-to-Display Latency (CDL) and frame rate

Omer Boyaci, Andrea Forte, Salman Abdulbaset and Henning Schulzrinne

[5] vDelay: A Tool to Measure Capture-to-Display Latency and Frame-rate
Omer Boyaci, Andrea Forte, Salman Abdul Baset, Henning Schulzrinne
International Symposium on Multimedia, December, 2009, San Diego, CA
[6] Demonstration of vDelay: A Tool to Measure Capture-to-Display Latency and Frame-rate
Omer Boyaci, Andrea Forte, Salman Abdul Baset, Henning Schulzrinne
International Symposium on Multimedia, Demo paper, December, 2009, San Diego, CA

vDelay: A tool to measure Capture-to-Display Latency (CDL) and frame rate

- Measures CDL and FPS of any video chat session
- Useful tool for comparing video chat clients
- Black-box testing
- Does not require access to source code or protocol messages
- Does not require extra hardware (except an external webcam)
- Java – works in all operating systems

vDelay: A tool to measure Capture-to-Display Latency (CDL) and frame rate

Screenshot of the receiver side vDelay application.
FPS, CDL, and FRR statistics are shown at the top of the image.
The barcode received from the caller agent is also visible.

SECE: Sense Everything, Control Everything

Omer Boyaci, Victoria Beltran and Henning Schulzrinne

[7] Bridging communications and the physical world: Sense Everything, Control Everything
Omer Boyaci, Victoria Beltran, Henning Schulzrinne
IPTComm'11, August 2011, Chicago, IL
[8] Bridging communications and the physical world: Sense Everything, Control Everything
Omer Boyaci, Victoria Beltran, Henning Schulzrinne
IEEE Globecom 2010 Workshop on Ubiquitous Computing and Networks, Dec 10, 2010 , Miami, FL
[9] Demonstration of Bridging communications and the physical world: Sense Everything, Control Everything
Omer Boyaci, Victoria Beltran, Henning Schulzrinne

Overview

- SECE allows **non-technical users** to create **services** that combine
  - communication
  - calendaring
  - location
  - devices in the physical world
- SECE: *event-driven* system
  - uses high-level *event languages*
  - to trigger action scripts, written in Tcl

Events & actions

Events

- Presence updates
- Incoming calls
- Email
- Calendar entries
- Sensor inputs
- Location updates

Actions

- Control the delivery of email
- Route phone calls
- Update social network status
- Control actuators such as lights
- Reminders (email, voice call, SMS)
- Interact with Internet services

Event language syntax

```
every sunset {
   homelights on;
}

every week on WE at 6:00 PM{
   email irt_list “Pizza talk at 6:00 PM today.”;
}

if stock.google > 580 {
   sms me "google stock: [stock google]";
}
```

Event Rules: More Examples

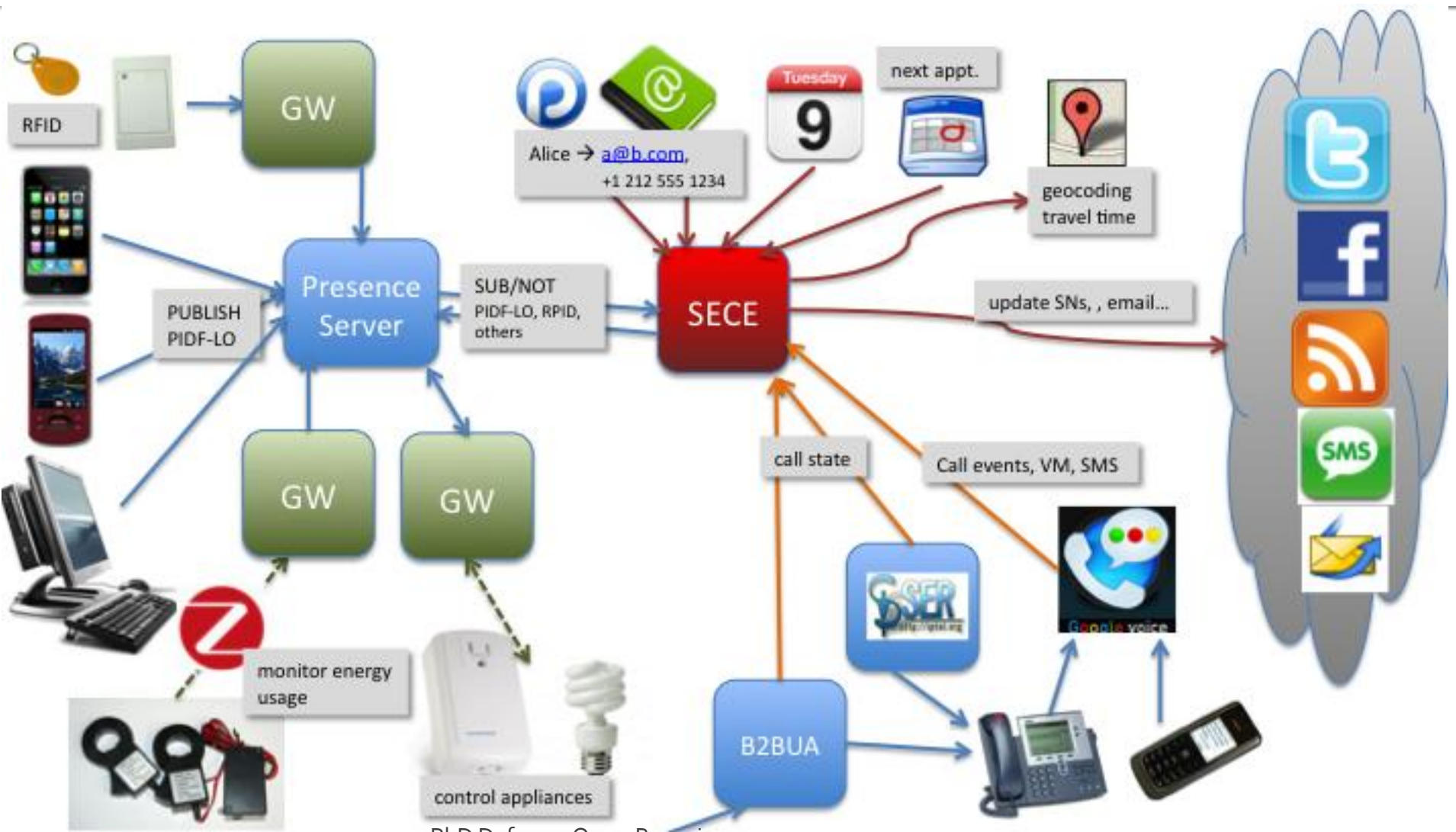
Extensible set of small languages

- Time
  - Single `on February 16, 2010 at 6:00 PM`
  - Recurring `every day at 12:00 until April`
- Location
  - `Tom within 5 miles of me`
- Context
  - `if my office.temperature > 80`
- Communication requests
  - `incoming call`

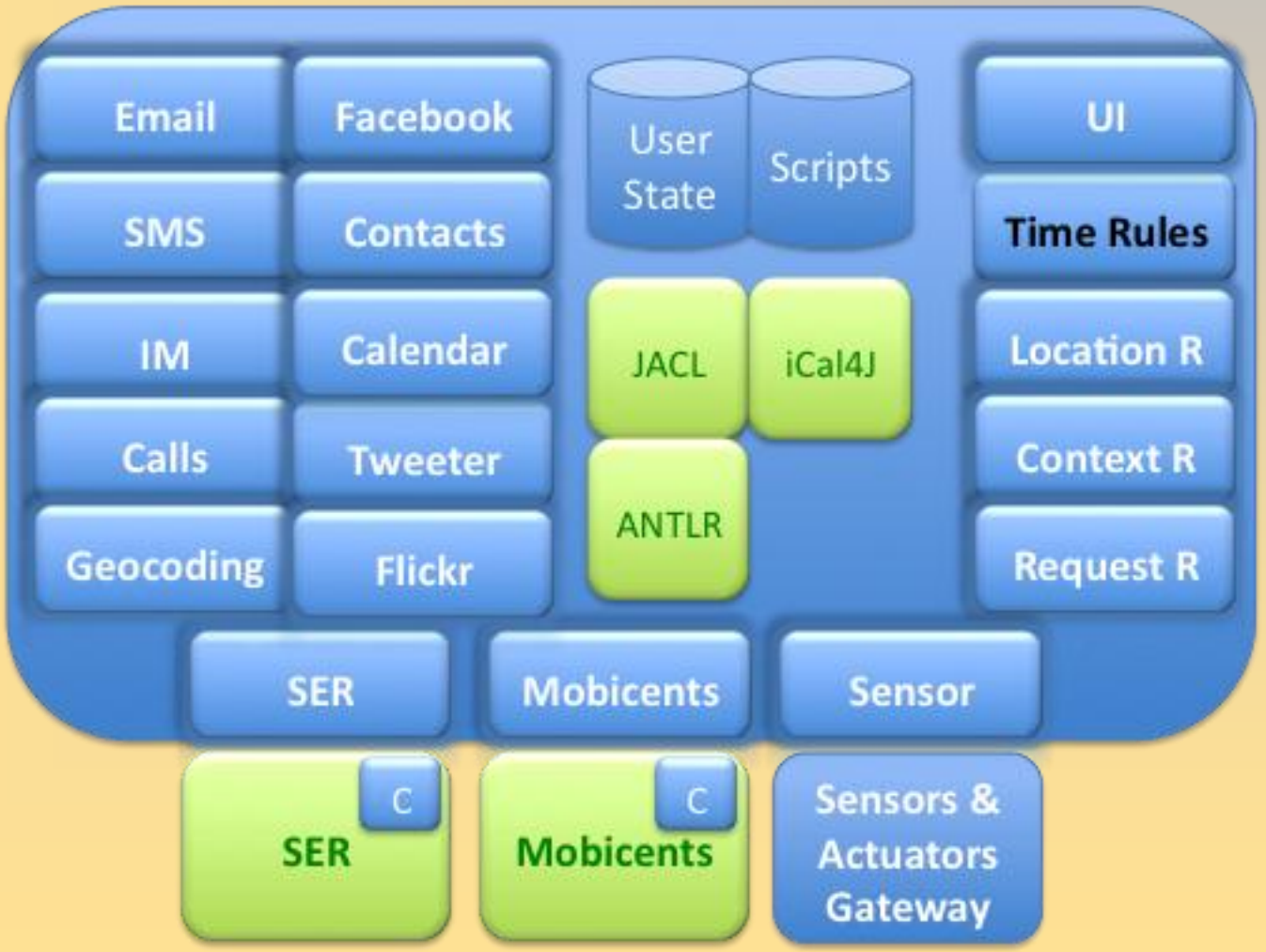
Related Work

Systems	User rules	User actions	Communications	Time	Location	Presence	Sensors	Web services	Actuators
SECE	NL-like rules	Tcl scripts	Call, email, IM	✔	User & buddies	✔	✔	✔	✔
CPL	XML tree	Fixed XML actions	Call	✖	✖	✖	✖	✖	✖
LESS	XML tree	XML actions	Call	✔	✖	✔	✖	✖	X10, vcr
SPL	script	Signaling actions	Call	✖	✖	✖	✖	✖	✖
VisuCom	Graphical UI	Signaling actions	Call	✖	✖	✖	✖	✖	✖
DiaSpec	Java	Java	✔✖	✖✔	✖✔	✖✔	✖✔	✖✔	✖✔
CybreMinder	Form based	Reminder	✖	✔	✔	✖	✔	✖	✖
Task.fm	Time rule	Reminder	✖	✔	✖	✖	✖	✖	✖

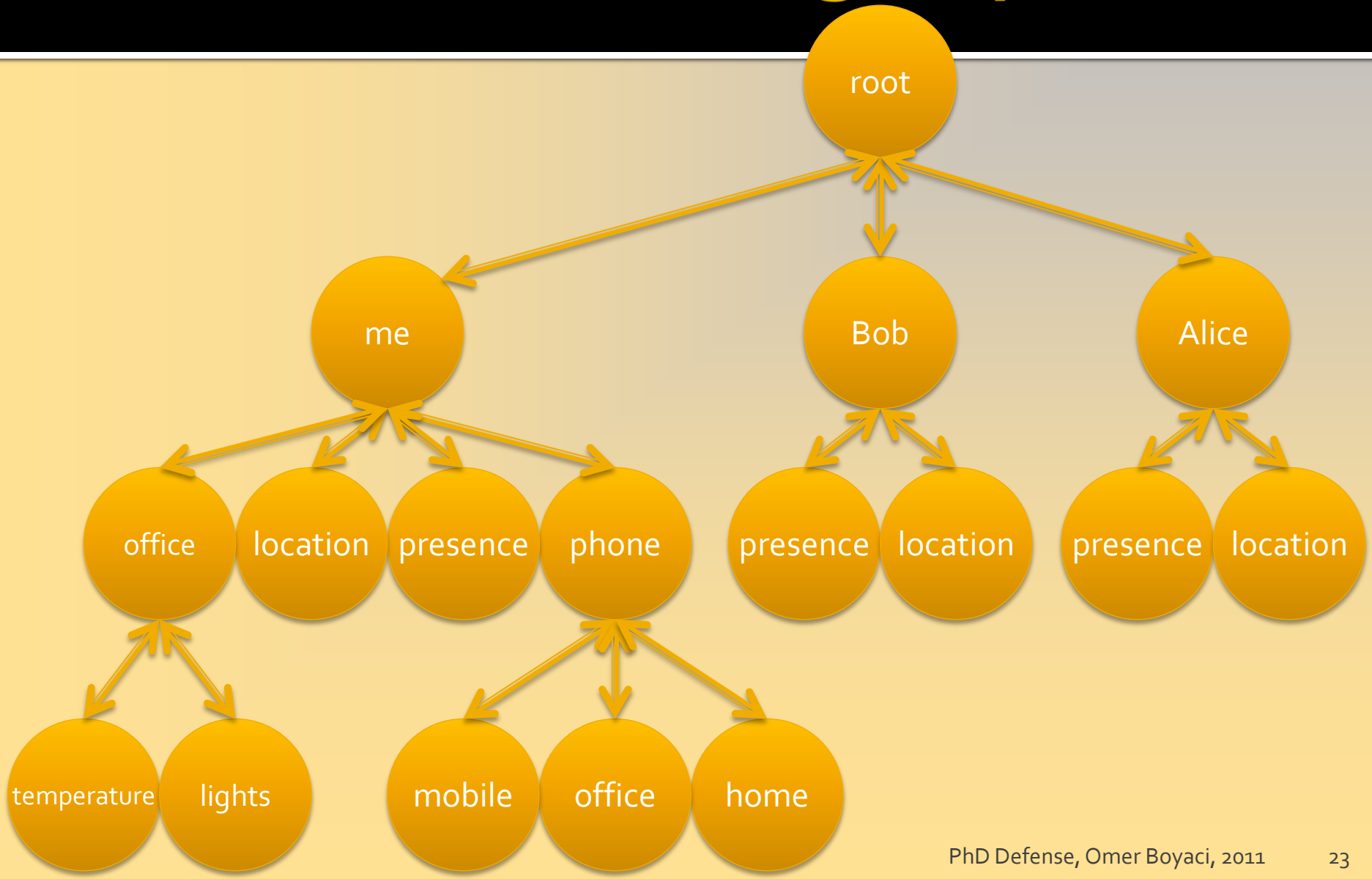
The big picture



Software architecture



User information registry



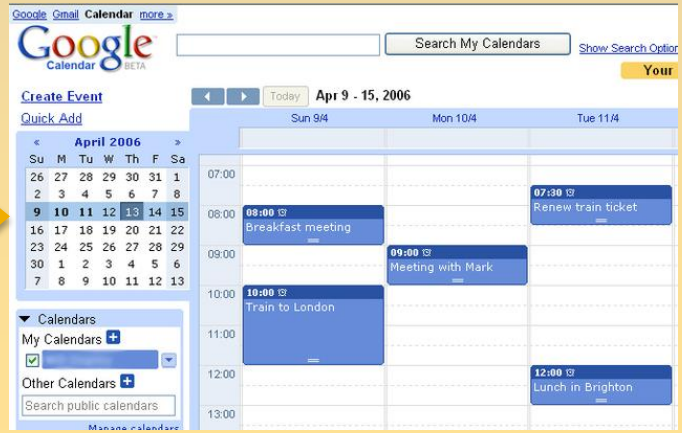
SECE: Time-based rules

Every day at 12:00 from 01/01/2010 until 04/01/2010 {
email employees "lunch time" "Location: 5th floor Dinning Room, Time: 12:30"
}

BEGIN:VCALENDAR
BEGIN:VEVENT
DTSTART;TZID=America/New_York:20100101T12000
o RRULE:FREQ=DAILY;BYHOUR=12;
UNTIL=20100401T120000
END:VEVENT
END:VCALENDAR

SECE

Export / Import



SECE: Location-based rules

user operator location { body }

bob near "Columbia University"
me near 40.807,-73.963

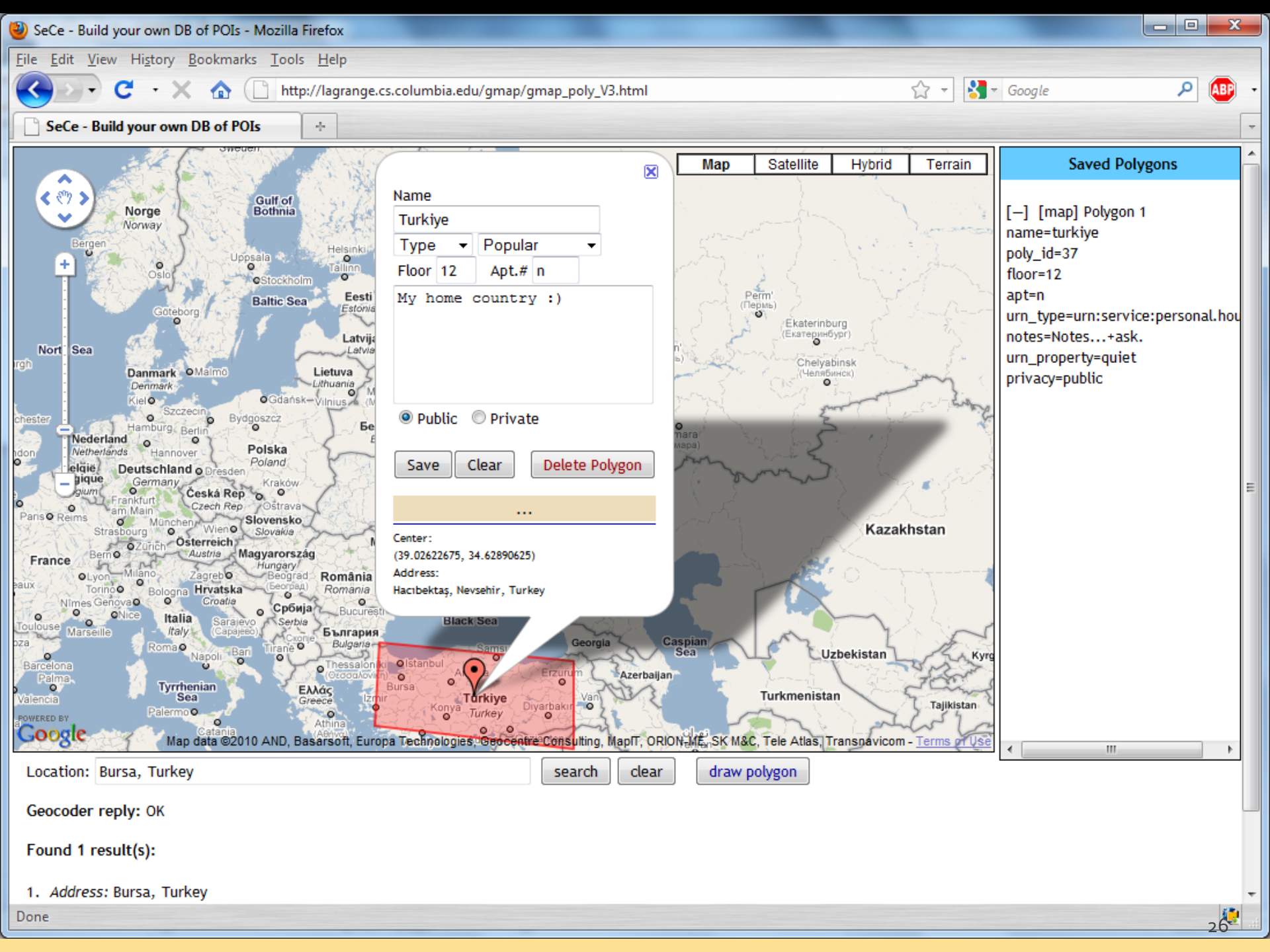
tom within 5 miles of me
me within 3 miles of "2960 Broadway, New York, 10027"

tom in "Rockefeller center"
Me outside of "Manhattan"

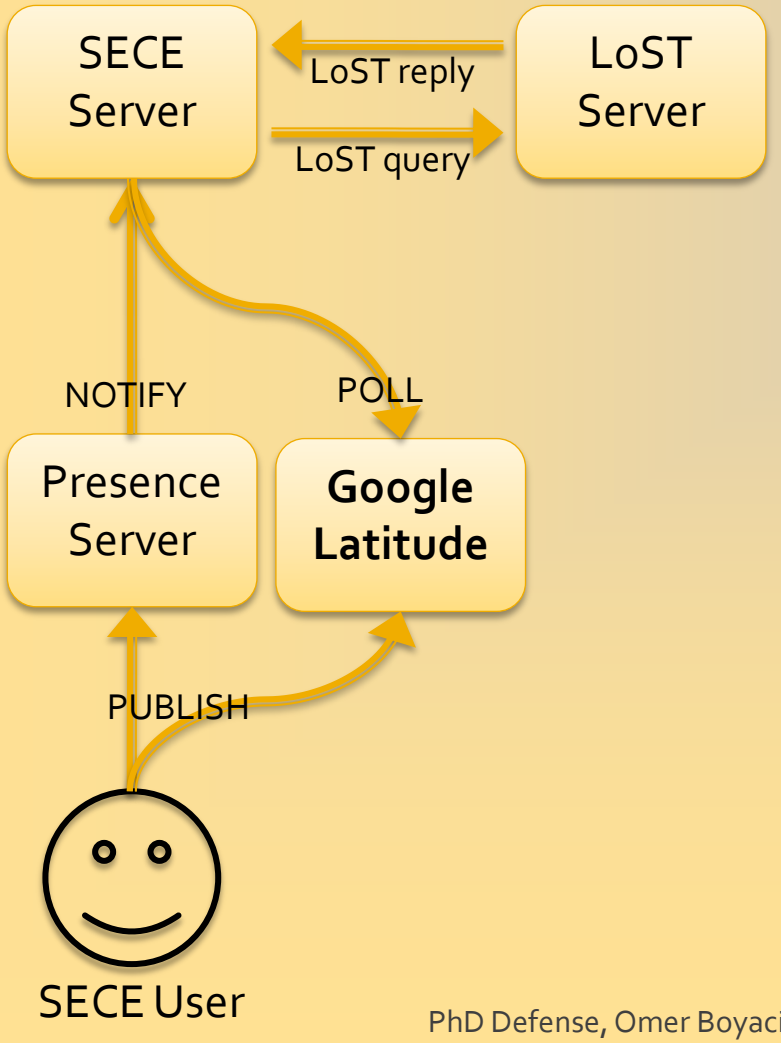
bob moved 1.5 miles

- Place types and user-defined locations:

me near a post office
Anne in a museum
me near my tennis club


SeCe - Build your own DB of POIs - Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://lagrange.cs.columbia.edu/gmap/gmap_poly_V3.html
SeCe - Build your own DB of POIs
Name
Turkiye
Type
Popular
Floor 12
Apt.# n
My home country :)
Public
Private
Save
Clear
Delete Polygon
...
Center:
(39.02622675, 34.62890625)
Address:
Hacıbektaş, Nevsehir, Turkey
Map
Satellite
Hybrid
Terrain
Saved Polygons
[–] [map] Polygon 1
name=turkiye
poly_id=37
floor=12
apt=n
urn_type=urn:service:personal.hou
notes=Notes...+ask.
urn_property=quiet
privacy=public
Map data ©2010 AND, Basarsoft, Europa Technologies, Geocentre Consulting, MapIT, ORION-ME, SK M&C, Tele Atlas, Transnavicom - Terms of Use
Location: Bursa, Turkey
search
clear
draw polygon
Geocoder reply: OK
Found 1 result(s):
1. Address: Bursa, Turkey
Done

Handling location updates



- User
  - publishes his/her location periodically (e.g., every 5 min) to a presence server or to a location service such as Google Latitude
- Presence server
  - notifies changes in location to SECE server
- Google Latitude (or similar service)
  - SECE retrieves user's location periodically
- SECE server
  - depending on user's defined rules, queries LoST server
- LoST server
  - replies with current information on user's surroundings
- SECE server
  - Takes action based on rules and contextual location information

SECE: Communication-based rules

incoming|outgoing **event** *from* **user|address** *to* **address { body }**

missed call from **user|address** *to* **address { body }**

received call from **user|address** *to* **address { body }**

- Event: *call, im, sms*, voicemail*, email* *(*only incoming)*

```
incoming call {
    if { [my activity] == "on-the-phone"}      forward sip:bob@example.com
}
outgoing call {
   if {[outgoing destination] == "18003456789"}    modify_call destination 12129397054
}
incoming call from Anne {
     if {[my location] != "office"}         auto_answer audio no_office.au –record
}
incoming im {
    sms me [incoming from] + " sent an im:“ + [incoming content]
}
```

SECE: Social Network Integration

Incoming *social_network* *message_type*

facebook	wallmesssage
twitter	newsmessage
linkedin	direct

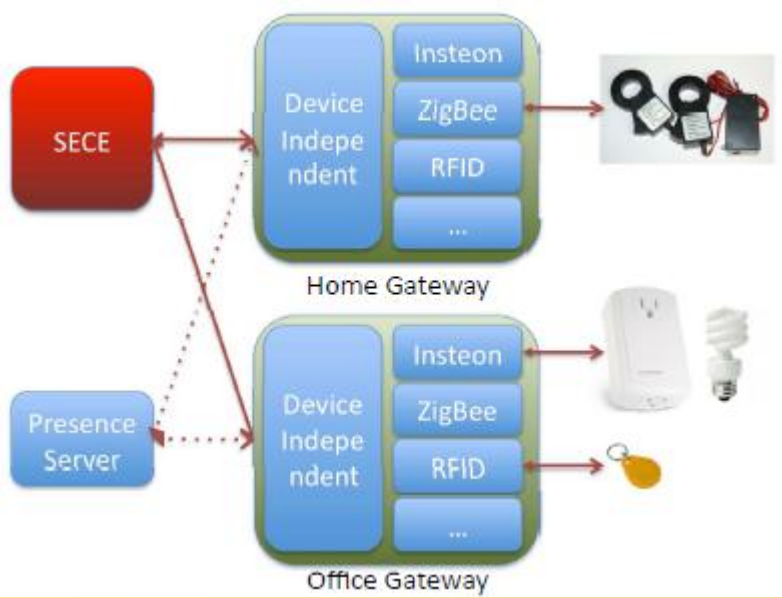
social_network *status_update*

facebook
twitter
linkedin

SECE Events and Actions

Context	Event	Action
Facebook	incoming wallmessage incoming newsmessage incoming direct	facebook
Twitter	incoming twitter direct incoming twitter wallmessage	tweet
Phone calls	incoming call incoming voicemail missed call outgoing call	call calltts accept reject forward
SMS	incoming SMS	sms
IM	incoming im outgoing im	im
Email	incoming email	email
Presence	if Bob is available	presence
Calendar	when [time] before [meeting] when [meeting] begins	schedule
Flickr		flickr
Translate		to_en, to_tr, ...
Location	near [landmark] within [dist] of [landmark] in [landmark] outside of [landmark]	
Time	on [time] every [time]	
Contextual	if [variable] [operator]	status [variable] [value]
Sensors	if office.motion equals true if office.temperature > 250	
Actuators		status office.light true

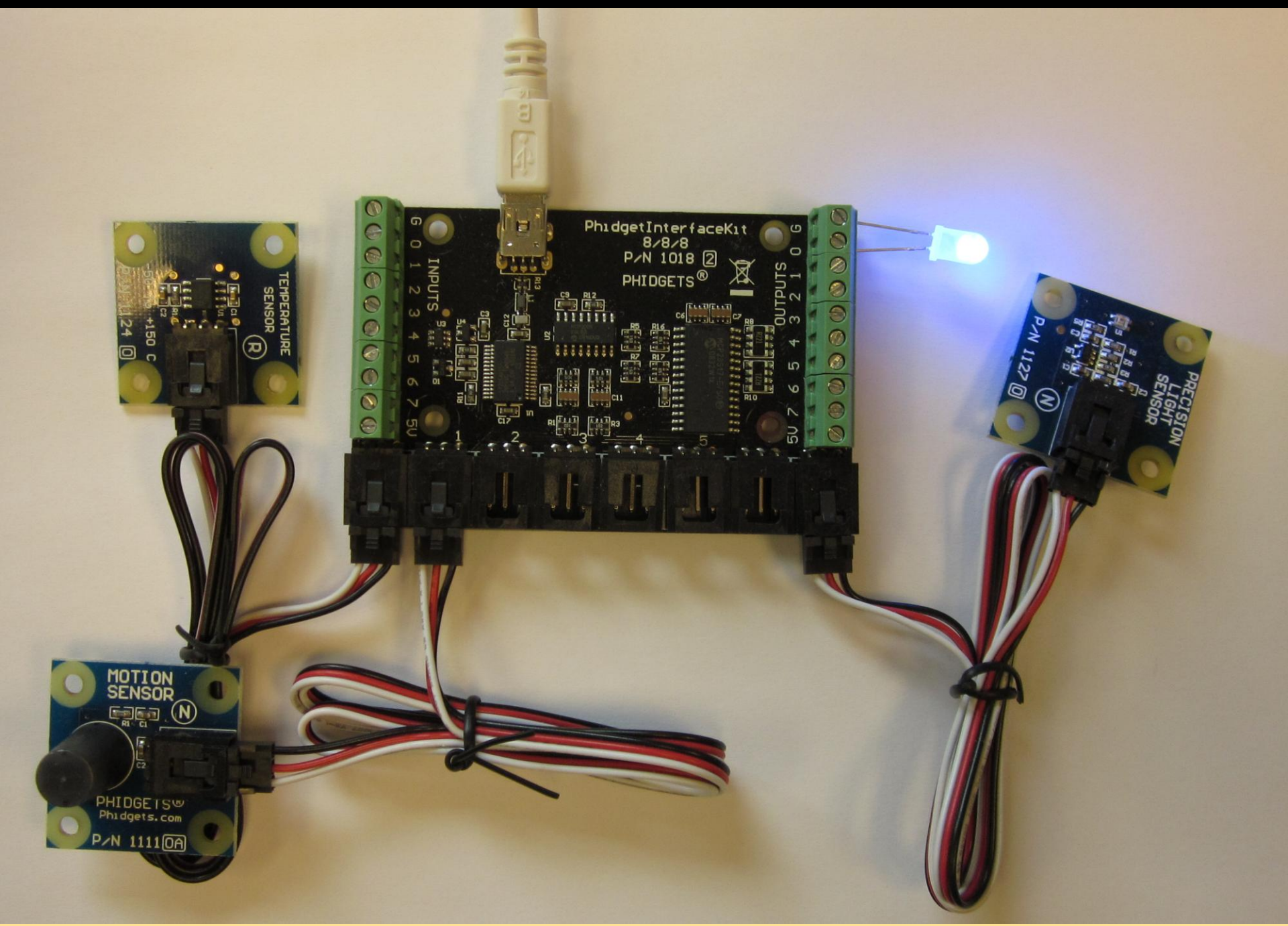
Sensors and Actuators



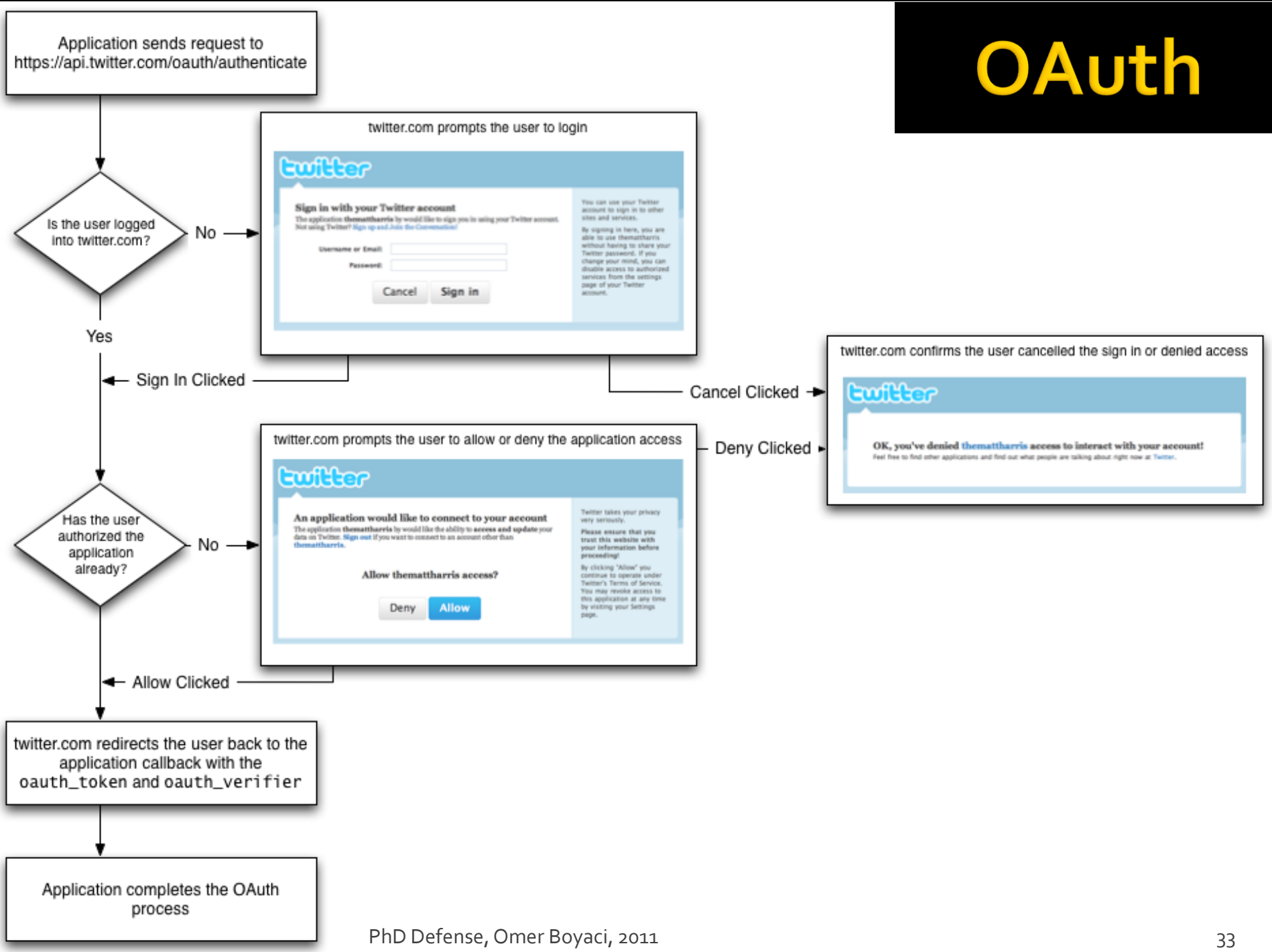
Sensors: smoke, light, humidity, motion, temperature and RFID readers

Actuators: networked devices and actuators such as lights, cameras, sprinklers, heaters, and air conditioners

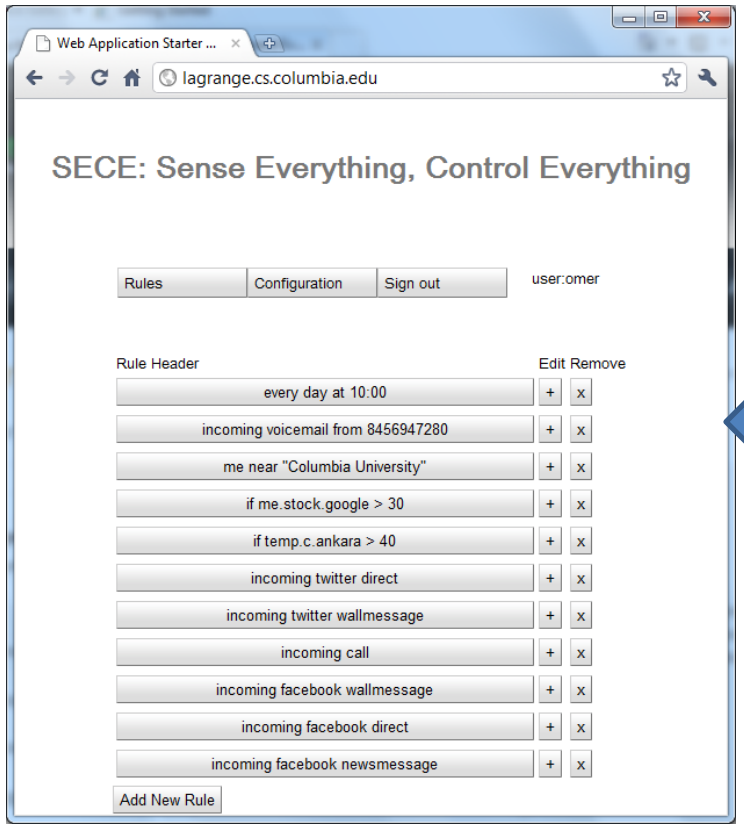
```
if my office.temperature > 80 {
    ac on;
}
if my office.smoke equals true {
    sprinklers on;
    sms me "fire in the office";
    call_tts fire-department "fire in the "+[get me.office.address];
    electrical-appliances off;
}
if my warehouse.motion equals true {
    sms me "person in the warehouse."
}
```

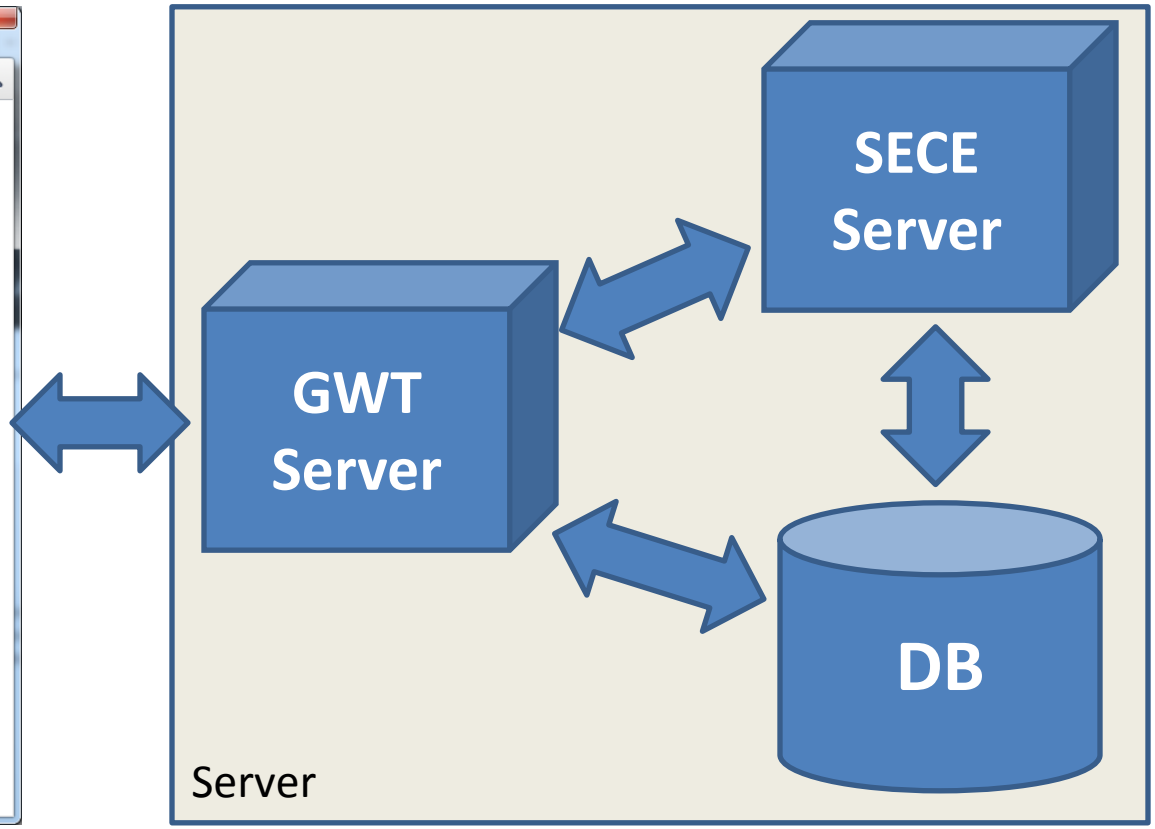

PhidgetInterfaceKit
8/8/8
P/N 1018
PHIDGETS
INPUTS
OUTPUTS
TEMPERATURE SENSOR
MOTION SENSOR
PHIDGETS
Phidgets.com
P/N 1111
PRECISION LIGHT SENSOR
P/N 1127

OAuth

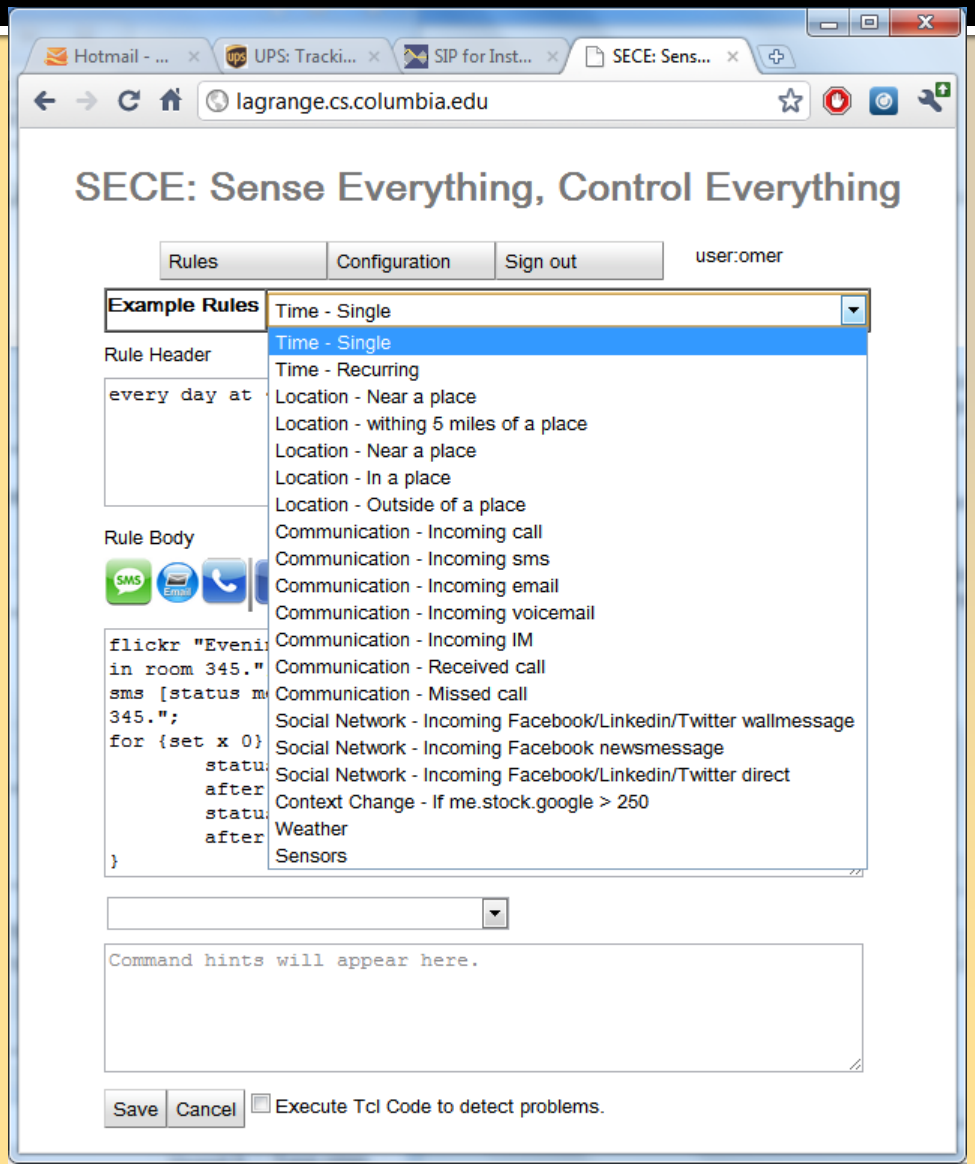

Application sends request to https://api.twitter.com/oauth/authenticate
Is the user logged into twitter.com?
No
twitter.com prompts the user to login
Sign in with your Twitter account
Username or Email:
Password:
Cancel
Sign in
Yes
Sign In Clicked
Cancel Clicked
twitter.com confirms the user cancelled the sign in or denied access
OK, you've denied themattharris access to interact with your account!
Deny Clicked
twitter.com prompts the user to allow or deny the application access
An application would like to connect to your account
Allow themattharris access?
Deny
Allow
Has the user authorized the application already?
No
Allow Clicked
twitter.com redirects the user back to the application callback with the oauth_token and oauth_verifier
Application completes the OAuth process

GUI (Google Web Toolkit - GWT)

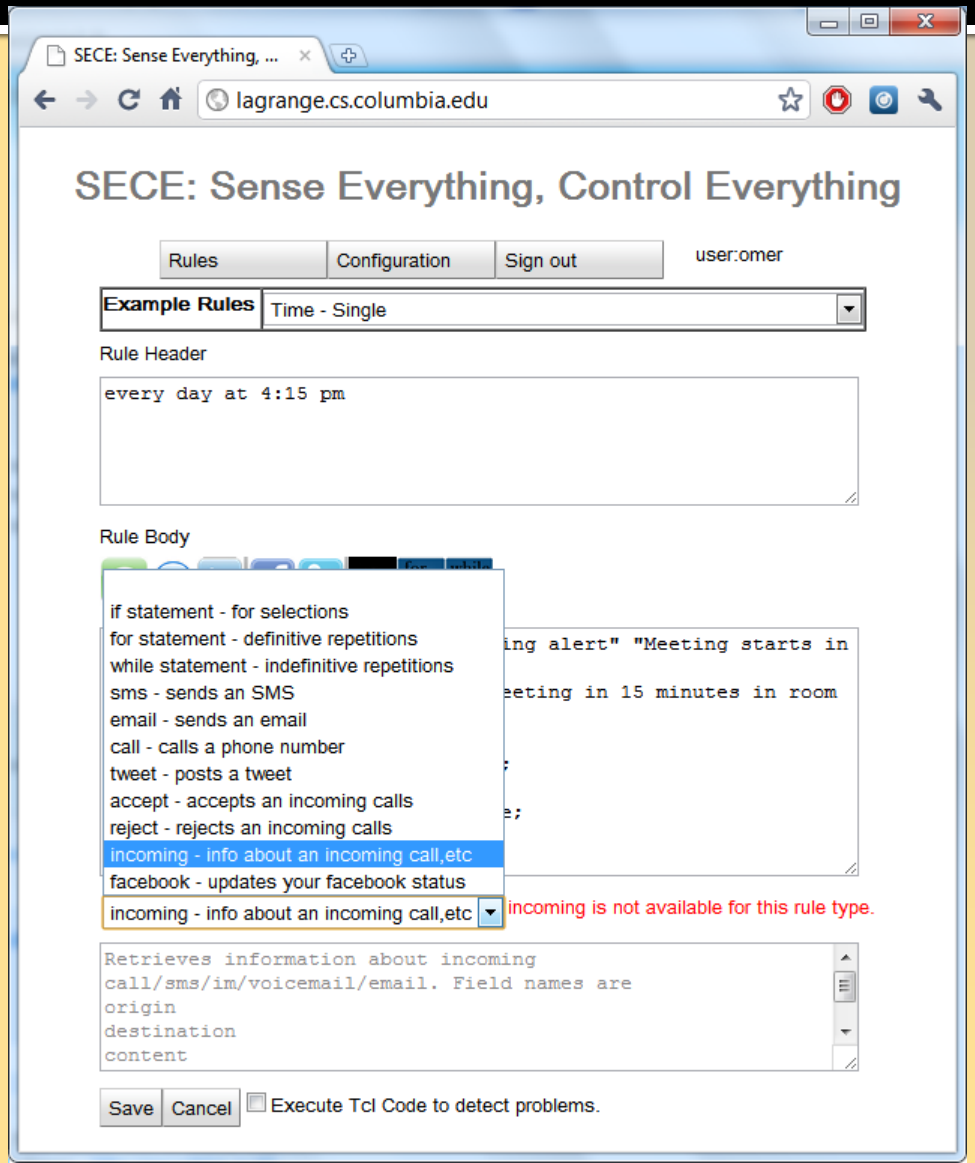




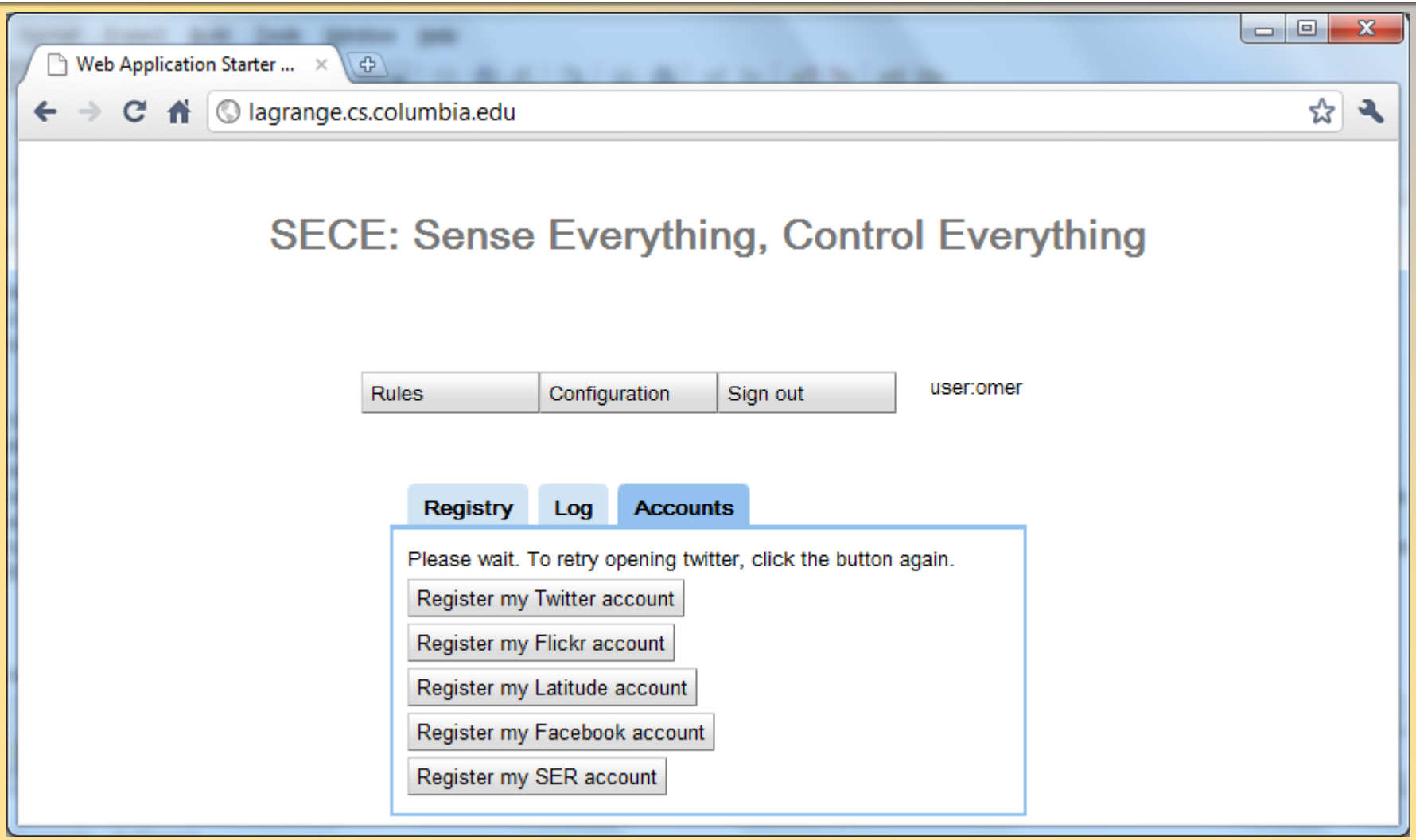
GUI- Example Rules



GUI- Action command assistant



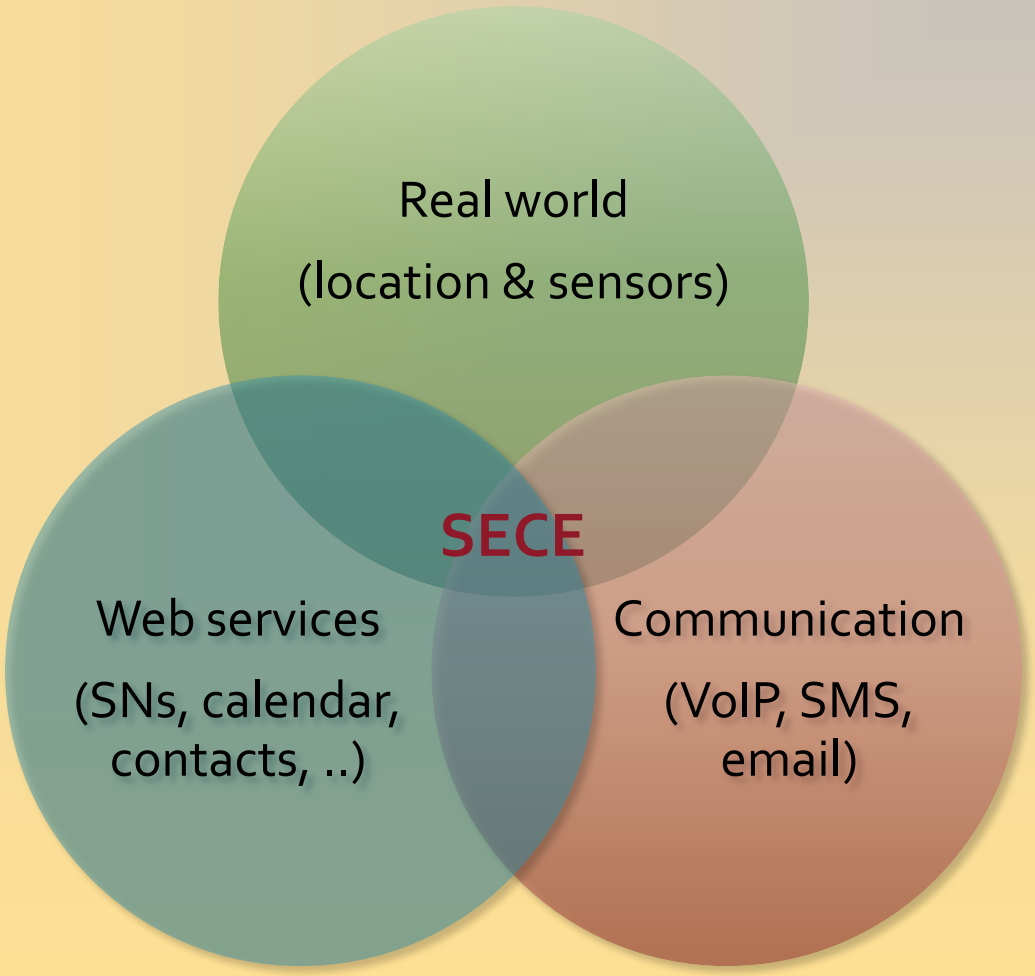
GUI- Registration of third-party services



Deployment Scenarios

- Can be deployed in a home device
  - protects privacy and security by keeping the rules and details of sensors and actuators within home boundaries.
  - it is more difficult to update the rules from anywhere.
- Can be provided as a cloud service
  - controlling in-home devices can be challenging, given NATs.

Conclusion


Real world
(location & sensors)
SECE
Web services
(SNs, calendar, contacts, ..)
Communication
(VoIP, SMS, email)

Peer-reviewed conference publications

[1] Bridging communications and the physical world: Sense Everything, Control Everything
Omer Boyaci, Victoria Beltran, Henning Schulzrinne
IPTComm'11, August 2011, Chicago, IL
[2] Bridging communications and the physical world: Sense Everything, Control Everything
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[4] Performance of video chat applications under congestion
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[5] vDelay: A Tool to Measure Capture-to-Display Latency and Frame-rate
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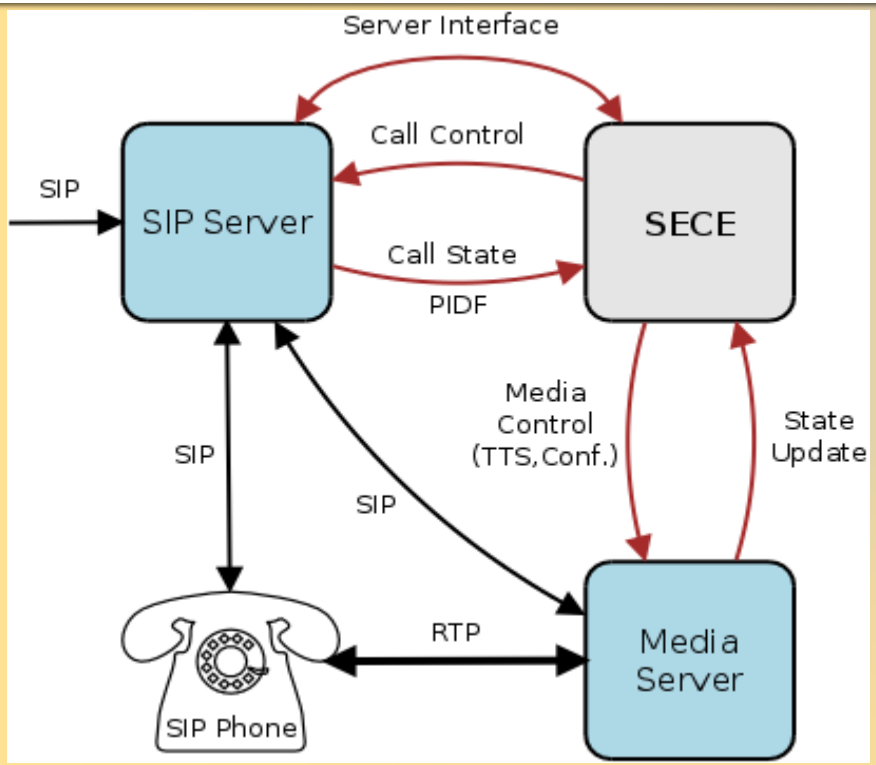
ACM CoNEXT 2007, student workshop, December, 2007, New york, NY

Backup slides

Automated Call Handling



- **Control**: Accept, reject, redirect, forward calls based on variety of SECE signals
- **Integration**: Calendar, address book, PSTN, Google Voice, SMS, location, Text-to-speech, voicemail)
- **Simplicity**: Natural, easy to learn scripting language
- **Flexibility:** Input from a variety of SECE components involved in call handling
- **Automation**: Scripts for recurring tasks (setup a conf. call based on calendar)

"On mom's birthday, call mom when I am home and near phone."
"Setup a conference call, enter password, invite people, ring desk phone."
"If driving and incoming call, play "user driving" and redirect to voicemail."
"If desk phone ringing and not in room, send SMS with caller's number."

Adding a new action command to the SECE

```
public boolean executeCode(Service service, String code) {
	//Creates a new Tcl interpreter
	Interp interp = new Interp();

	try {
		//Add new actions commands to the Tcl interpreter
		interp.createCommand("email", new EmailCmd(emailEventProducer));
		interp.createCommand("status", new StatusCmd(this));
		interp.createCommand("tweet", new TweetCmd(this));
		interp.createCommand("flickr", new FlickrCmd(this));
		interp.createCommand("facebook", new FacebookCmd(this));
		interp.createCommand("sms", new SMSCmd(googleVoice, service));
		interp.createCommand("im", new ImCmd(this));
		interp.createCommand("call", new CallCmd(null,googleVoice, service));
		interp.createCommand("incoming", new IncomingCmd(service));
		interp.createCommand("my", new MyCmd(this));
		interp.createCommand("accept", new AcceptCmd(service));
		interp.createCommand("reject", new RejectCmd(service));
		interp.createCommand("event", new EventCmd(service));
		interp.createCommand("schedule", new ScheduleCmd(this.googleCalendarHandler));
		TranslatorCmd st = new TranslatorCmd();
		for (final Language language : Language.values()) {
			interp.createCommand("to_"+language.toString(), st);
		}

		 // runs the user's Tcl script
		interp.eval(code);
	} catch (Exception ex) {
		return false;
	} finally {
		interp.dispose();
	}
	return true;
}
```

Adding a new action command to the SECE

```
package edu.columbia.lucs.tcl;
import com.restfb.DefaultFacebookClient;
import com.restfb.FacebookClient;
import com.restfb.Parameter;
import com.restfb.exception.FacebookException;
import com.restfb.types.FacebookType;
import edu.columbia.lucs.Manager;
import java.util.logging.Level;
import java.util.logging.Logger;
import tcl.lang.*;

public class FacebookCmd implements Command {
        Manager man;

         public FacebookCmd(Manager man) {
           this.man = man;
         }

         public void cmdProc(
              Interp interp, // Current interpreter.
              TclObject objv[]) // Arguments to "lsearch" command.
              throws TclException
         {
                   String token = man.reg.getRegistryAttribute("me.conf.facebook.acc1.token");
                   if (token != null) {
                             FacebookClient facebookClient = new DefaultFacebookClient(t);
                             try {
                                       FacebookType publishMessageResponse =
                                       facebookClient.publish("me/feed", FacebookType.class,Parameter.with("message", objv[1].toString()));
                             } catch (FacebookException ex) {
                                       Logger.getLogger(FacebookCmd.class.getName()).log(Level.SEVERE, null, ex);
                             }
                   }
        }
}
```