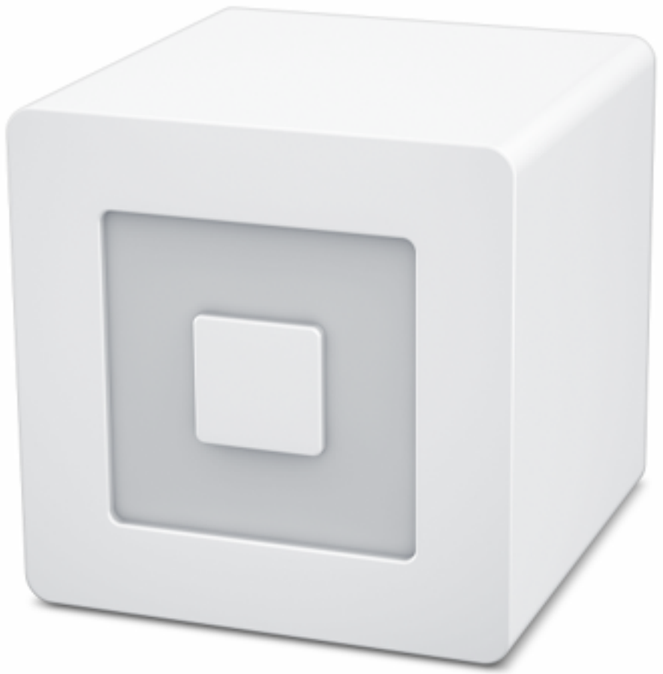


Android²

Bob Lee & Eric Burke

Square, Inc.

Square

Pay Eric Burke
$25.00
VISA 1111
Sign here.
Cancel
I agree to pay the above total amount
according to my card issuer agreement.
Continue

Overview

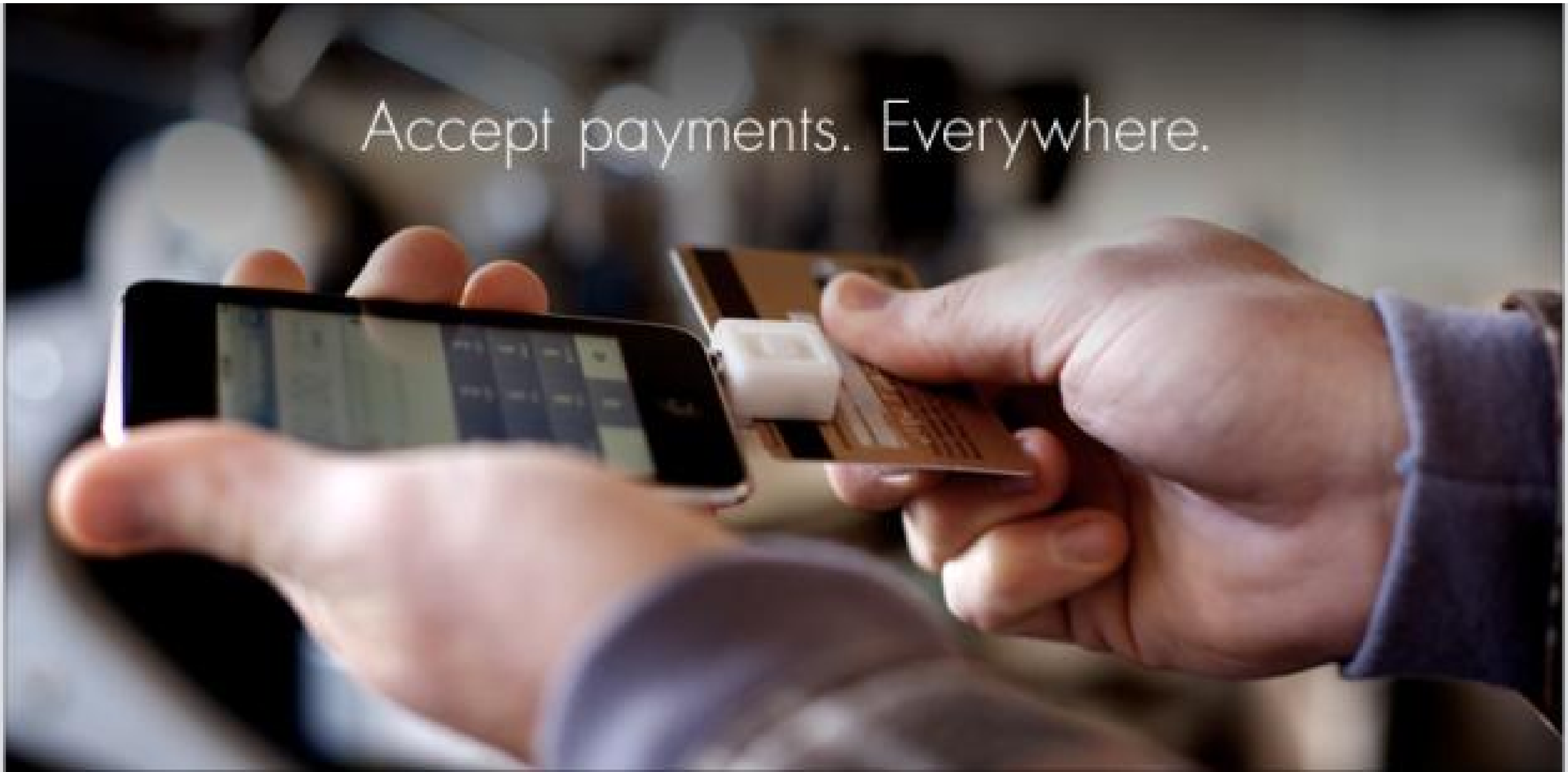
> Squarewave

> Retrofit

- I/O
- Shake detection
- REST

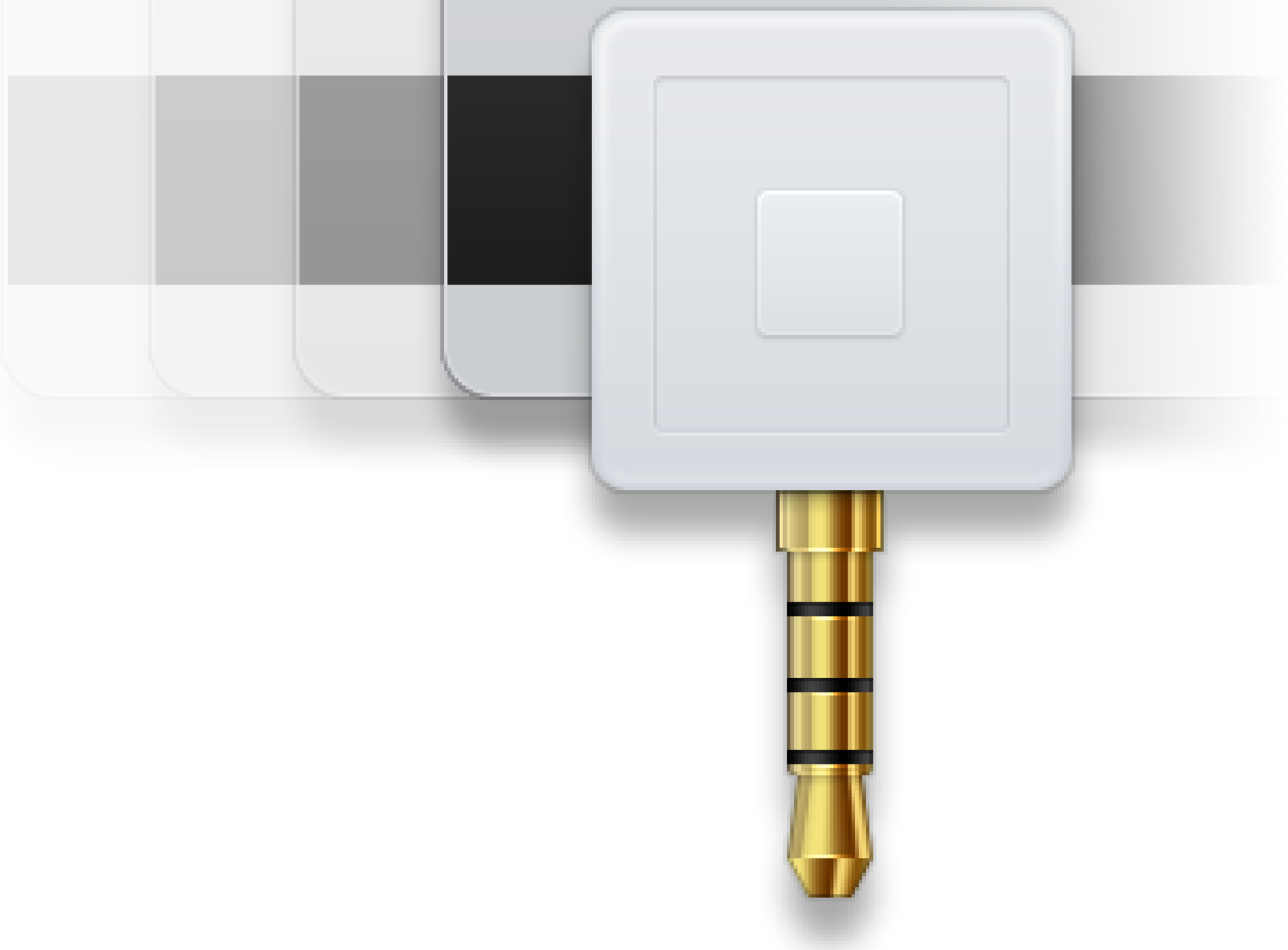
> Point-of-sale API

Squarewave: Magnetic Stripe Decoder

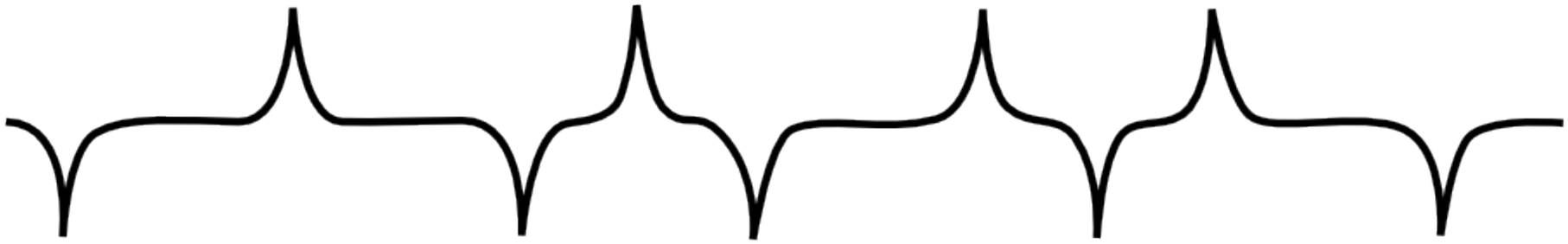


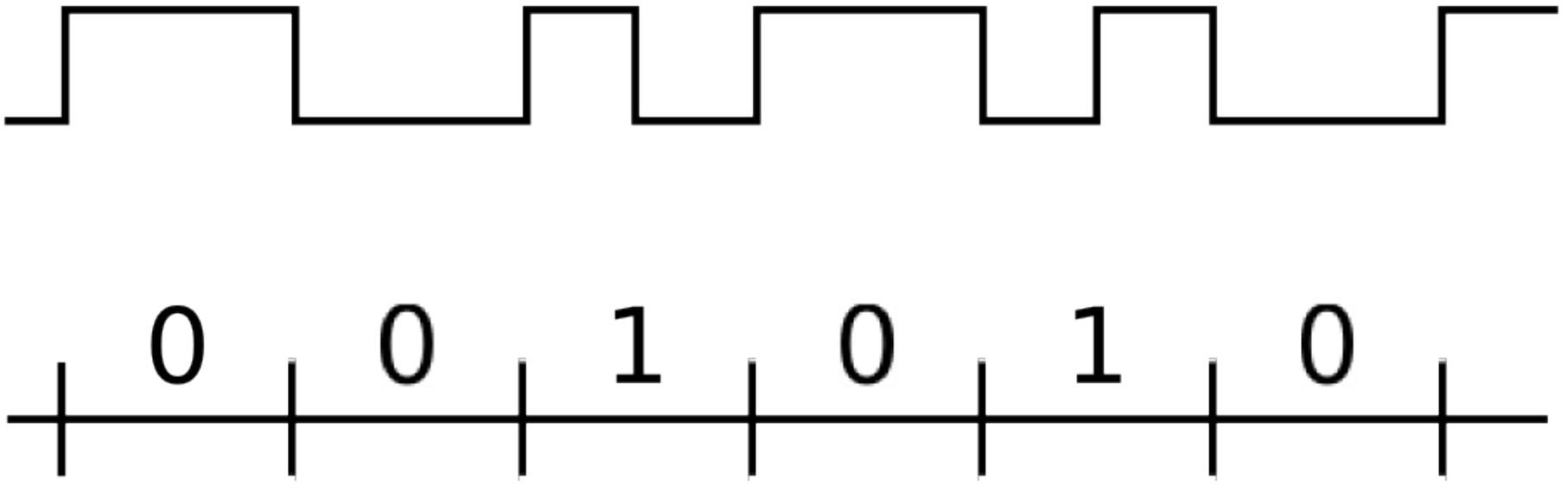
Square Reader

Acts as a microphone



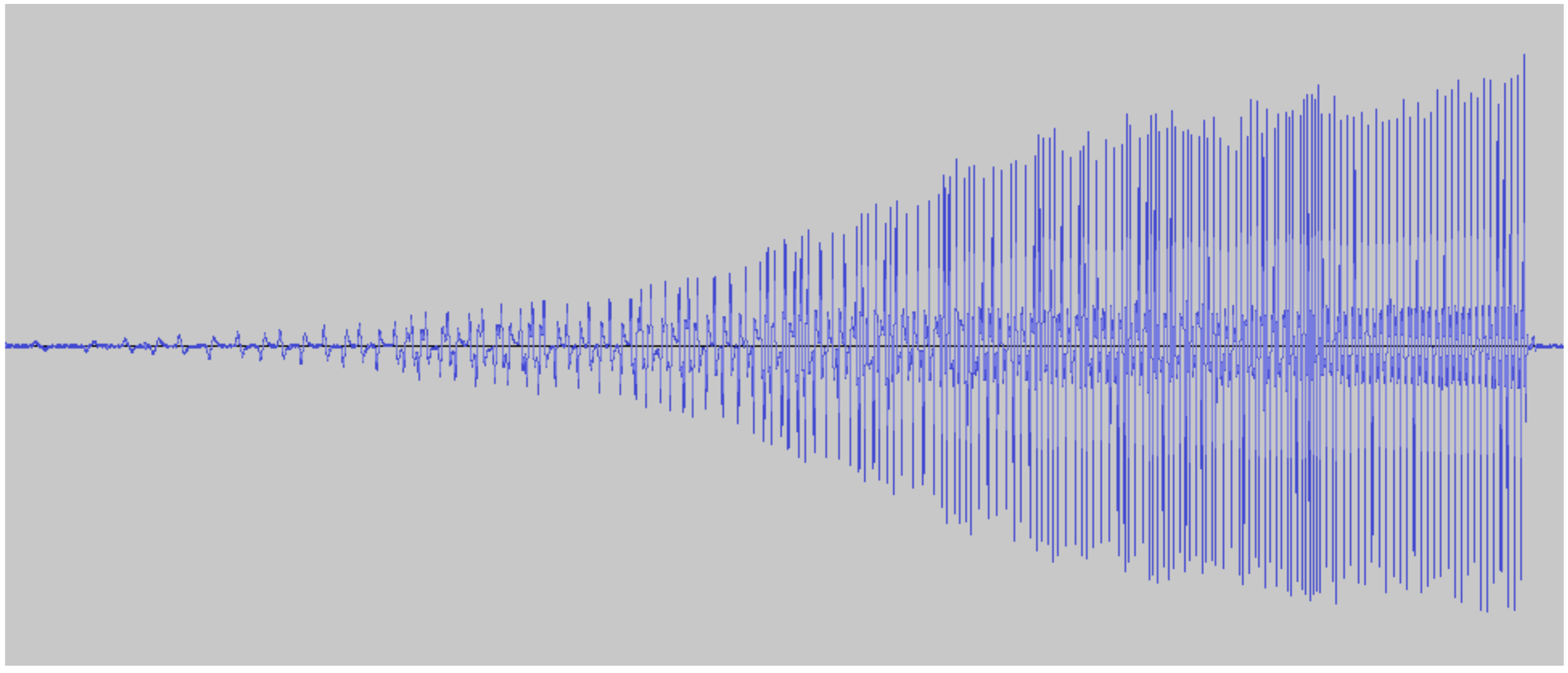
Ideal Waveform



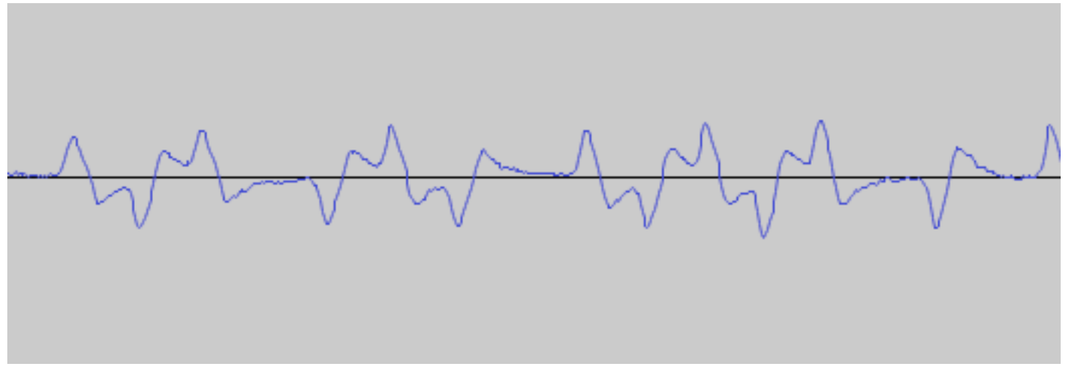


Sprint
11:27 AM
Charge
Doctor Evil
Settings
$10.00
Enter an optional note
Clear
9
8
6
7
5
3
4
2
1
0
00
SAMSUNG

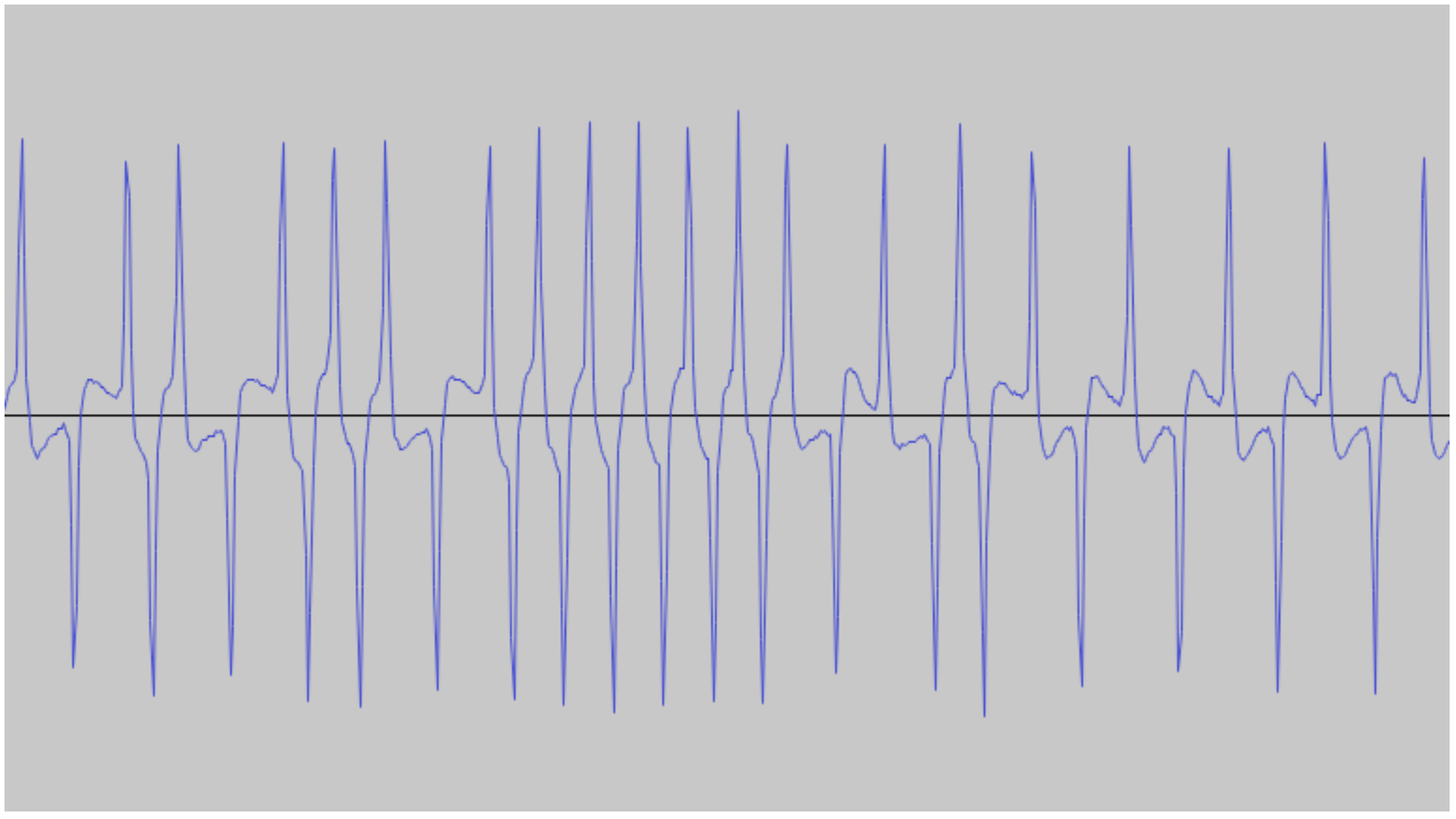
Actual Swipe Recording



Swipe Start



Swipe End



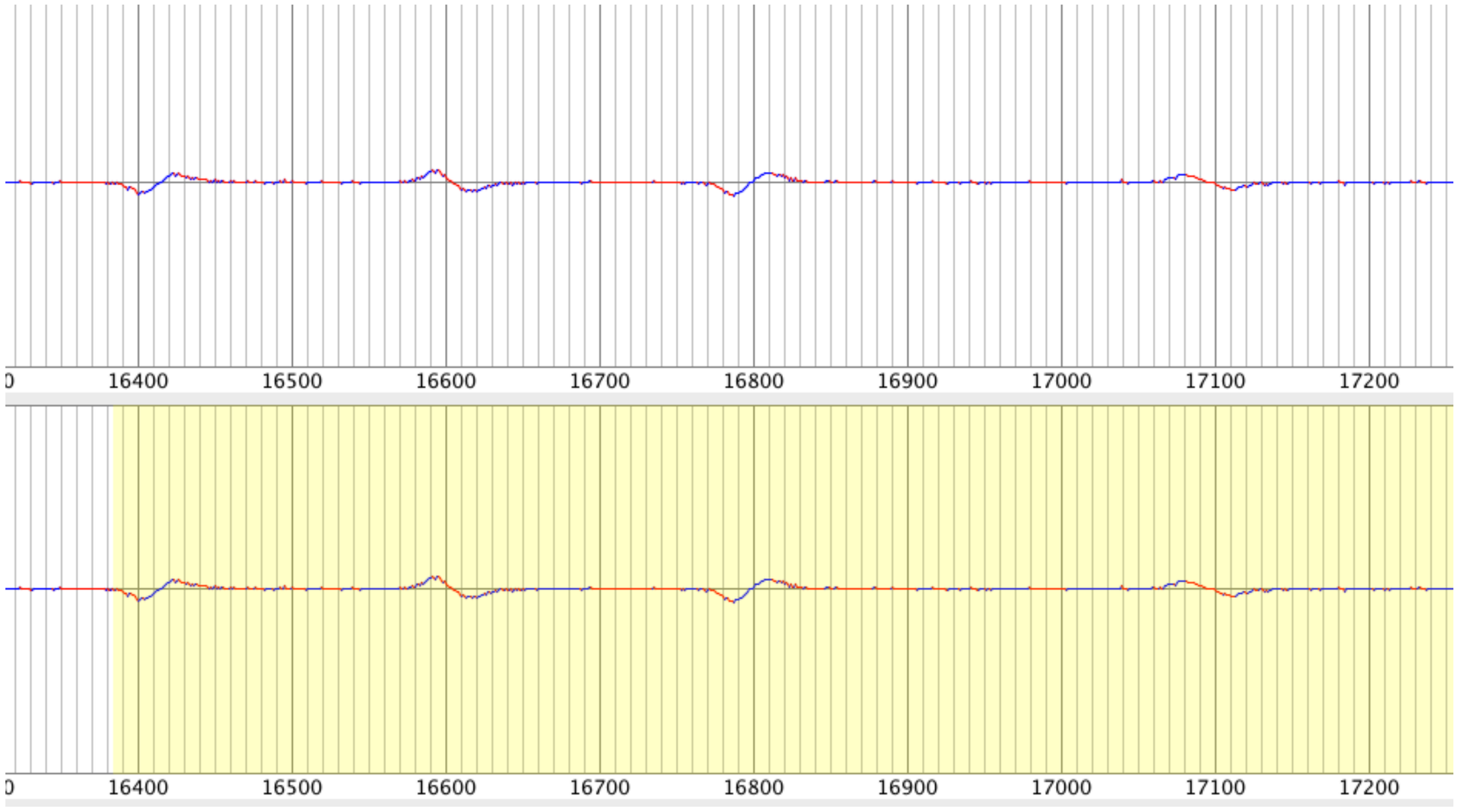
Challenges

> Swipe speed

> Device sample rate

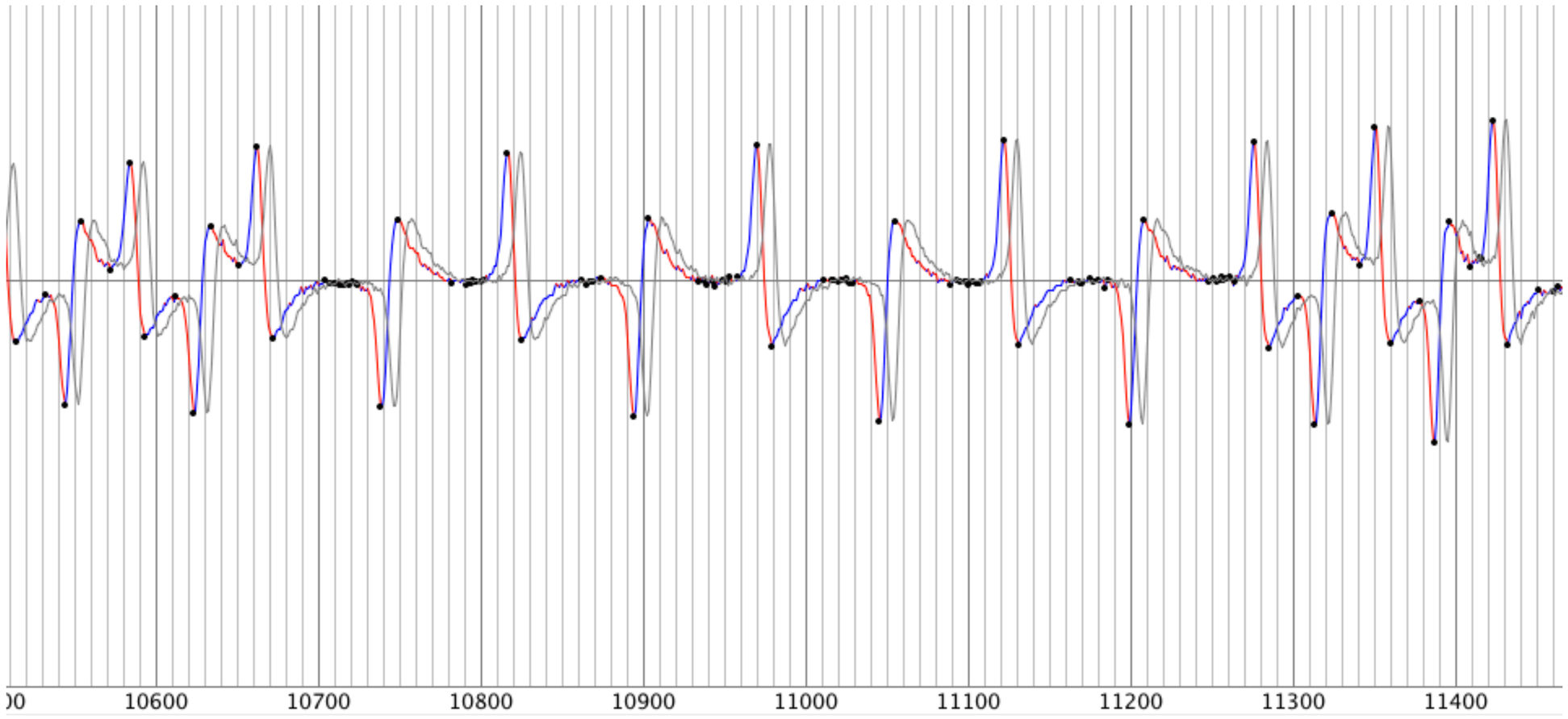
> Audio correction

Step 1: Swipe Detection

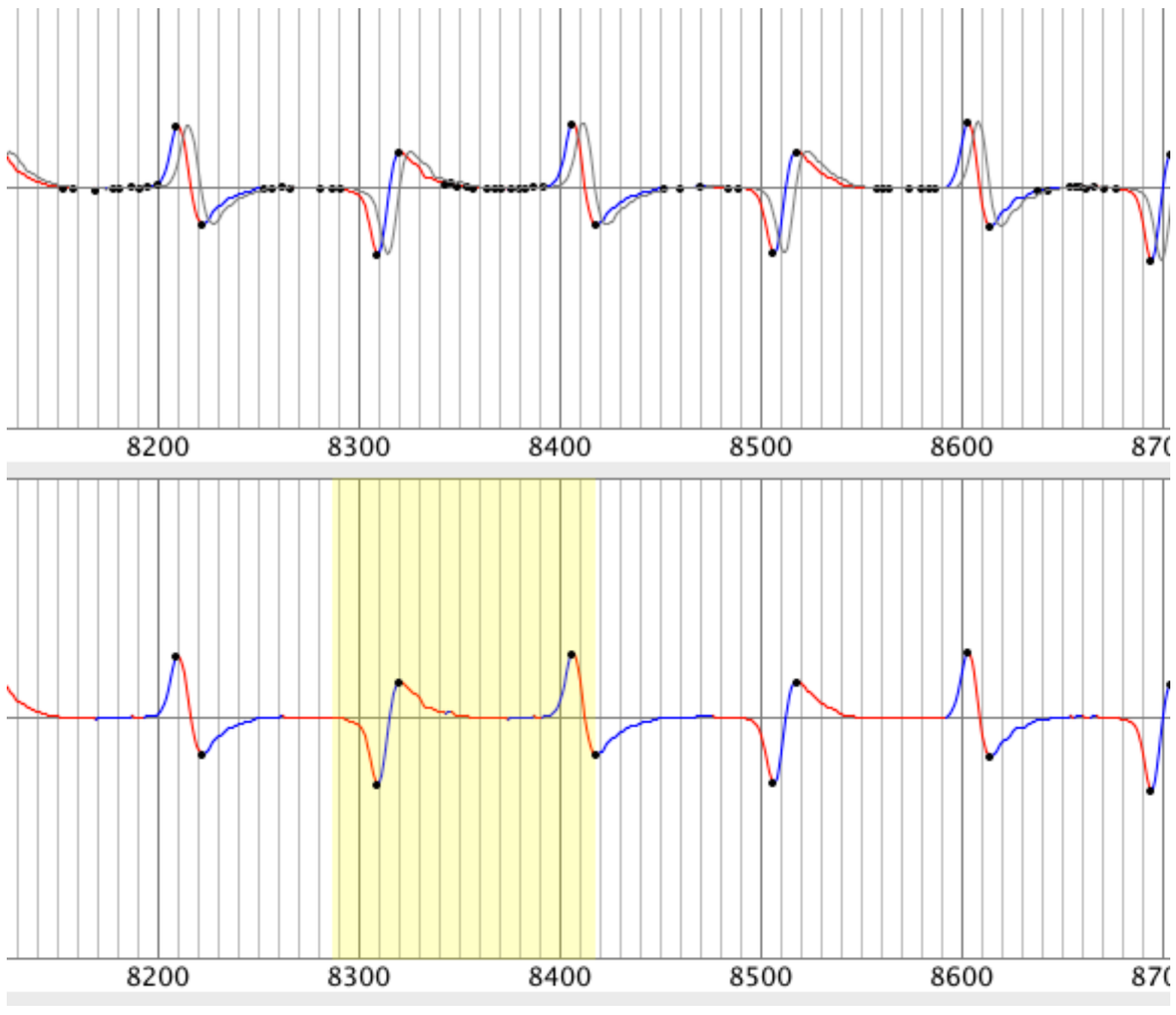


Step 2: Denoising

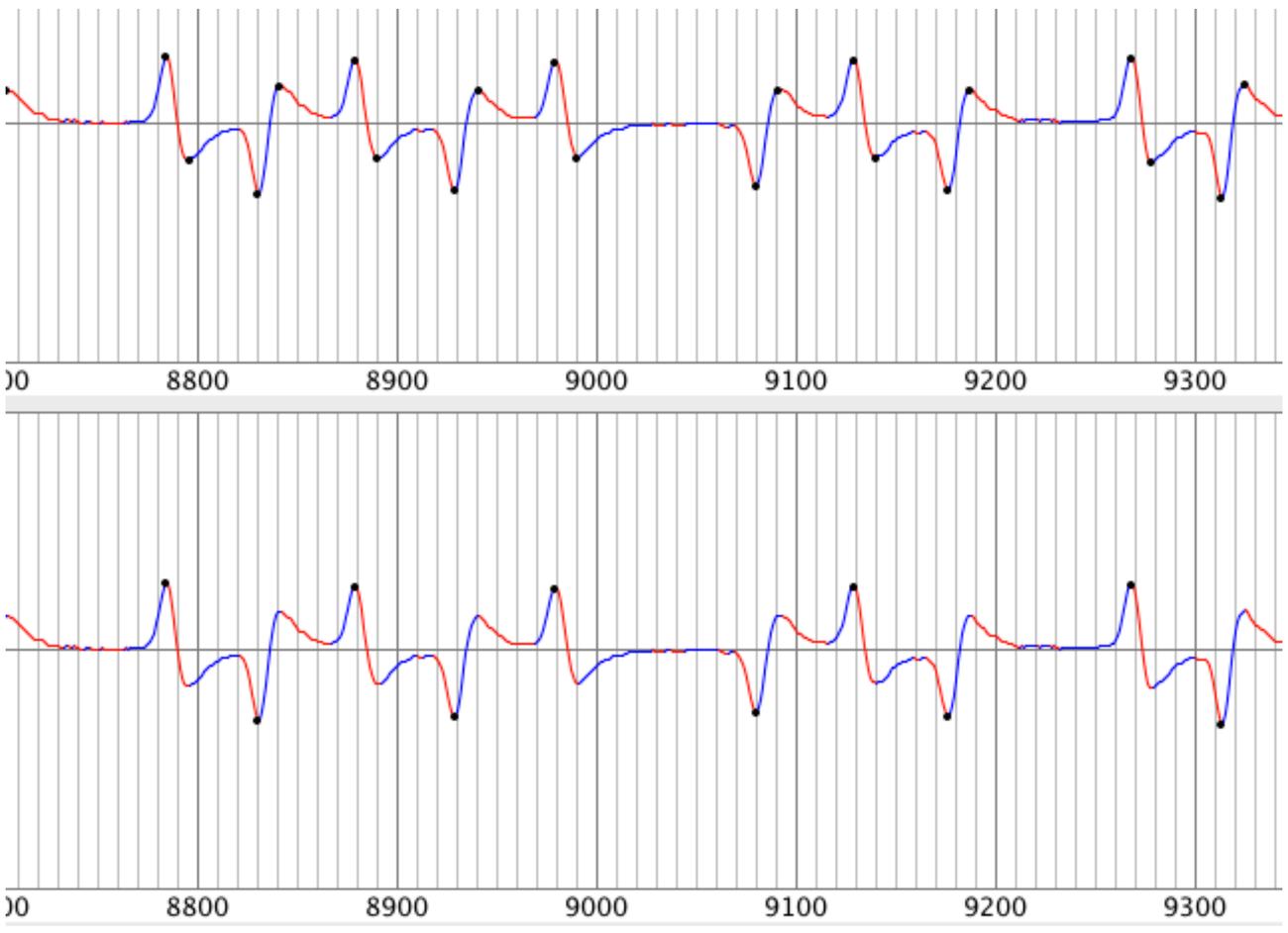
Step 3: Peak Detection



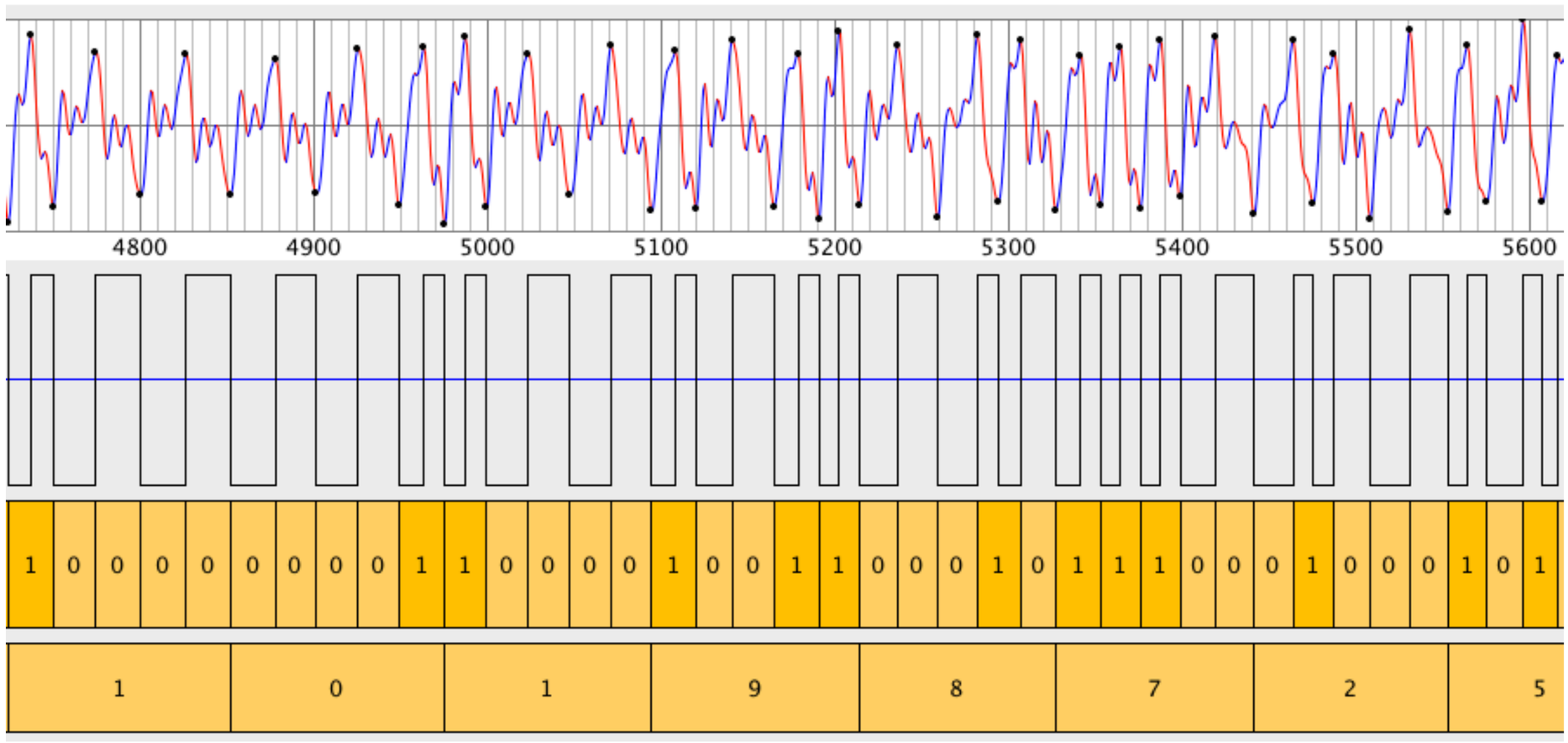
Step 4: Window Peak Removal



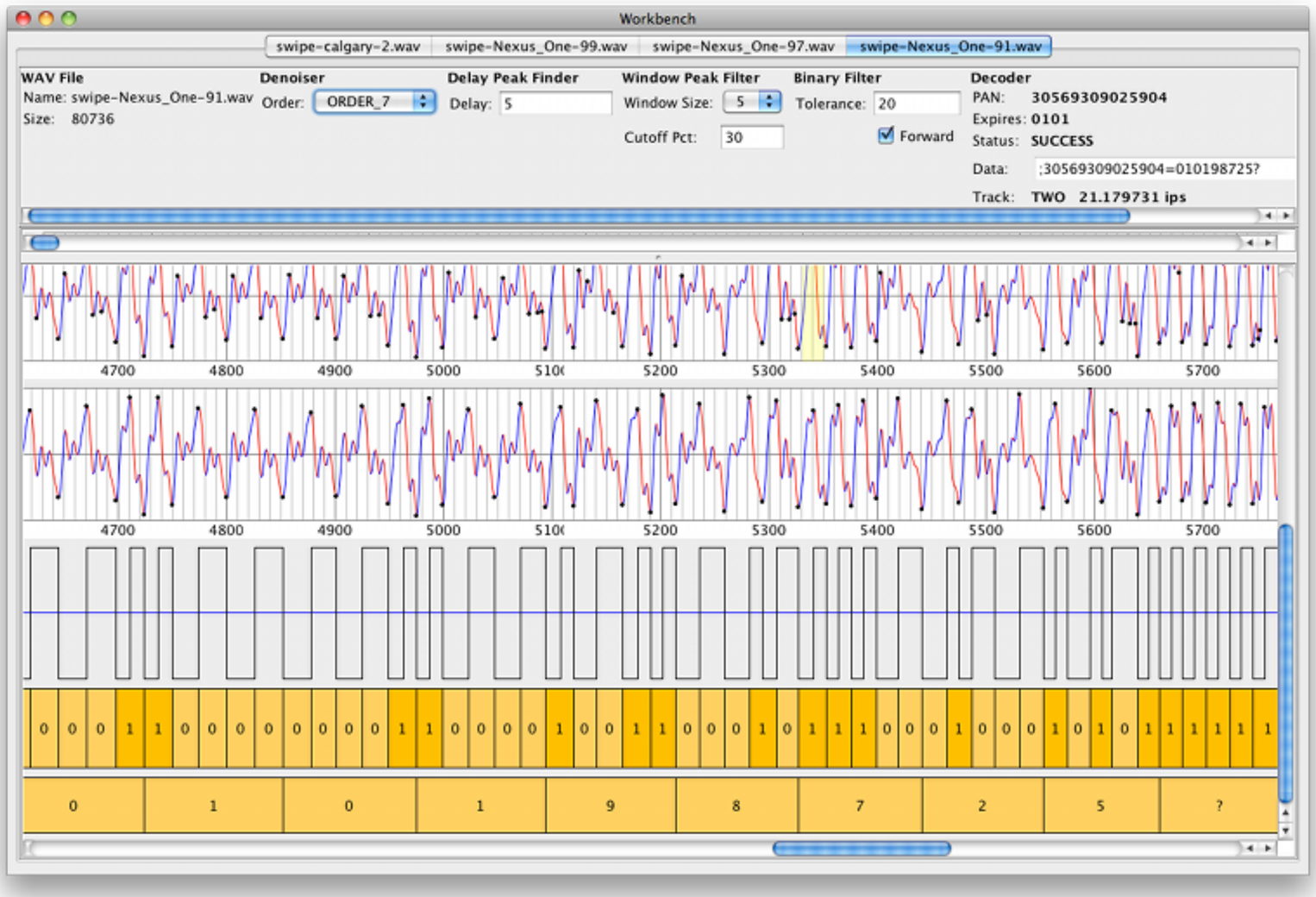
Step 5: Consecutive Peak Removal



Step 6: Decoding



Workbench


Workbench
swipe-calgary-2.wav
swipe-Nexus_One-99.wav
swipe-Nexus_One-97.wav
swipe-Nexus_One-91.wav
WAV File
Name: swipe-Nexus_One-91.wav
Size: 80736
Denoiser
Order: ORDER_7
Delay Peak Finder
Delay: 5
Window Peak Filter
Window Size: 5
Cutoff Pct: 30
Binary Filter
Tolerance: 20
Forward
Decoder
PAN: 30569309025904
Expires: 0101
Status: SUCCESS
Data: ;30569309025904=010198725?
Track: TWO 21.179731 ips
4700 4800 4900 5000 5200 5300 5400 5500 5600 5700
0 1 0 1 9 8 7 2 5 ?

Testing

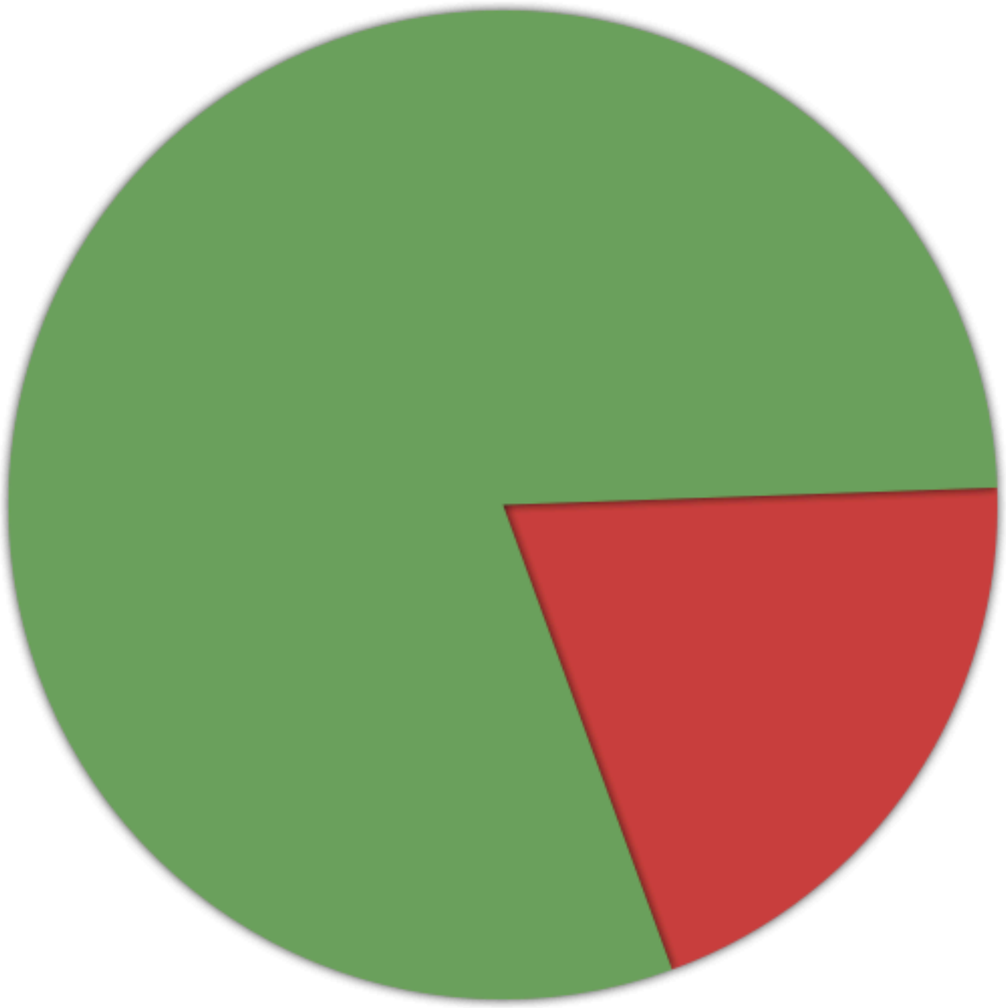
Find the Best Options

> Decode every swipe

> What percentage passed?

> Repeat

Good Enough?



95% Success!

> For the remaining 20%

> Find the best options again

ROBOT CHICKEN and all related characters and elements are trademarks and © 2005 Cartoon Network. All Rights Reserved. Photo, Colby Katz

Retrofit

> Extends Android and Java

> Apache-licensed

> Modules

- **`core`**
- **`io`**
- **`http`**
- **`android`**

> **`http://github.com/square/retrofit`**

Square for Android Persistence

> Queues

> Key-value pairs

> No SQL

Persistent Queue

> Sending data to a server

- Emails (Receipts)
- Image uploads
- Payments
- Analytics
- Crash dumps

> Histories

Traditional Approaches

> SQLite
  - Operations are O(log(n))
  - Rollback journal requires multiple operations
  - Write ahead log has other tradeoffs
  - **`xDeviceCharacteristics`**
> File-per-element
  - 4k/entry minimum
  - Several I/O operations

QueueFile

> All operations are O(1)

> Writes sync

> Writes are atomic

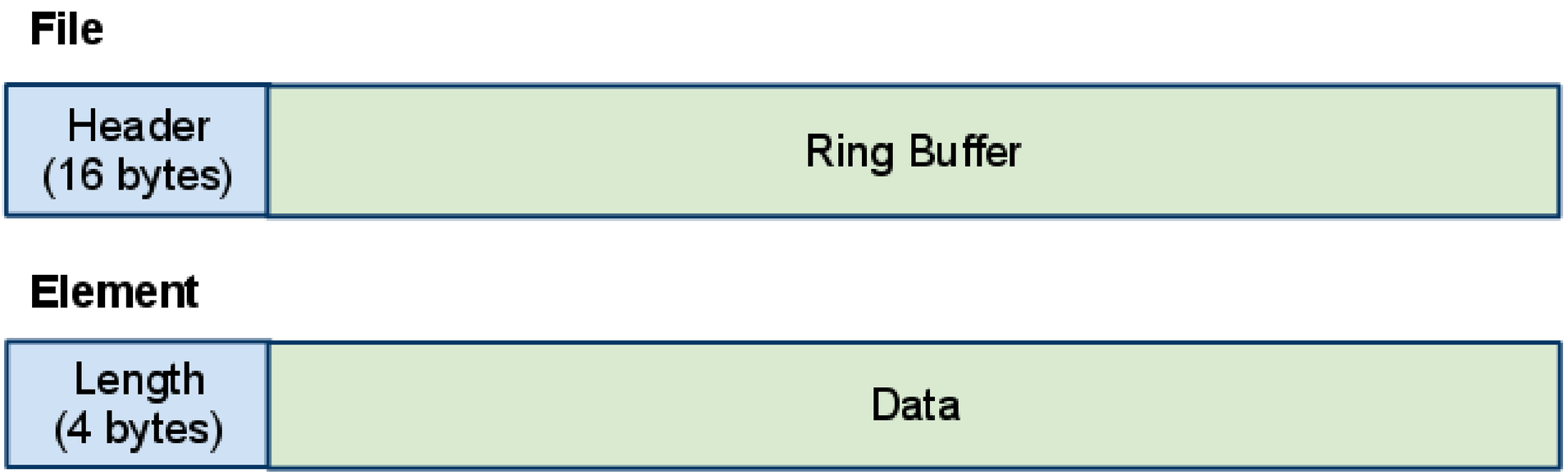
```
public class QueueFile {
  public QueueFile(File file) throws IOException { ... }

  public void add(byte[] data) throws IOException { ... }
  public void add(byte[] data, int offset, int count)
      throws IOException { ... }

  public byte[] peek() throws IOException { ... }
  public void remove() throws IOException { ... }

  public int size() { ... }
  public void clear() throws IOException { ... }
  public void close() throws IOException { ... }
}
```

The Implementation

> Depends somewhat on YAFFS

- Yet Another Flash File System
- Android's preeminent file system
- Supports atomic sector writes

> Writing the header commits a change

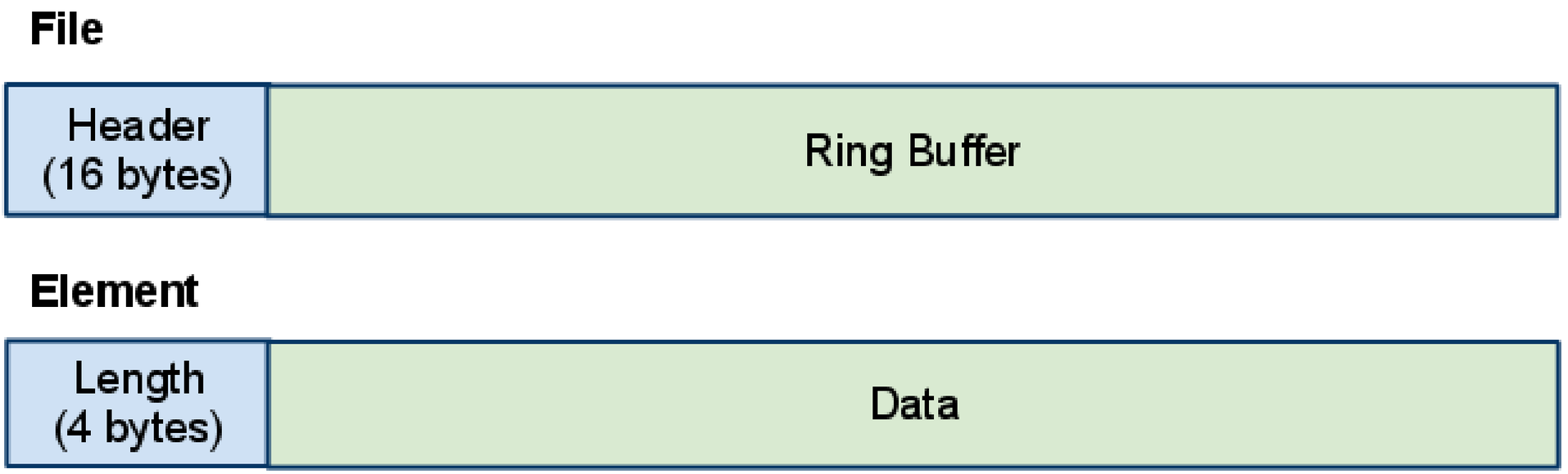


`QueueFile.add()`

> Write element data

> Write header (16 bytes < 4k)

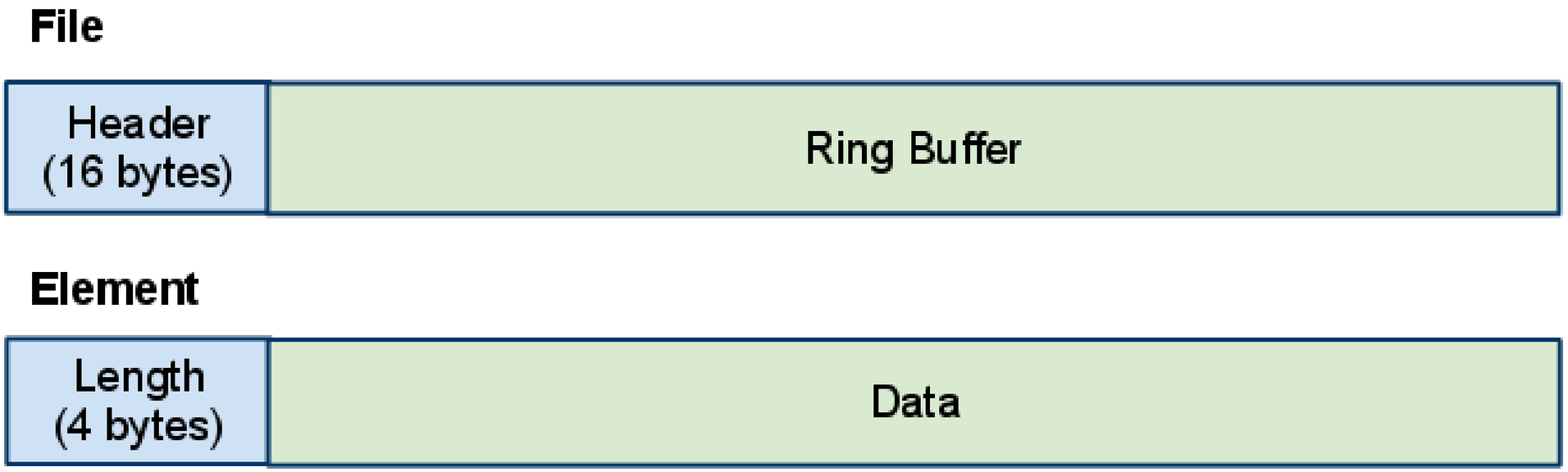
> Update in-memory state



`QueueFile.remove()`

> Write header

> Update in-memory state



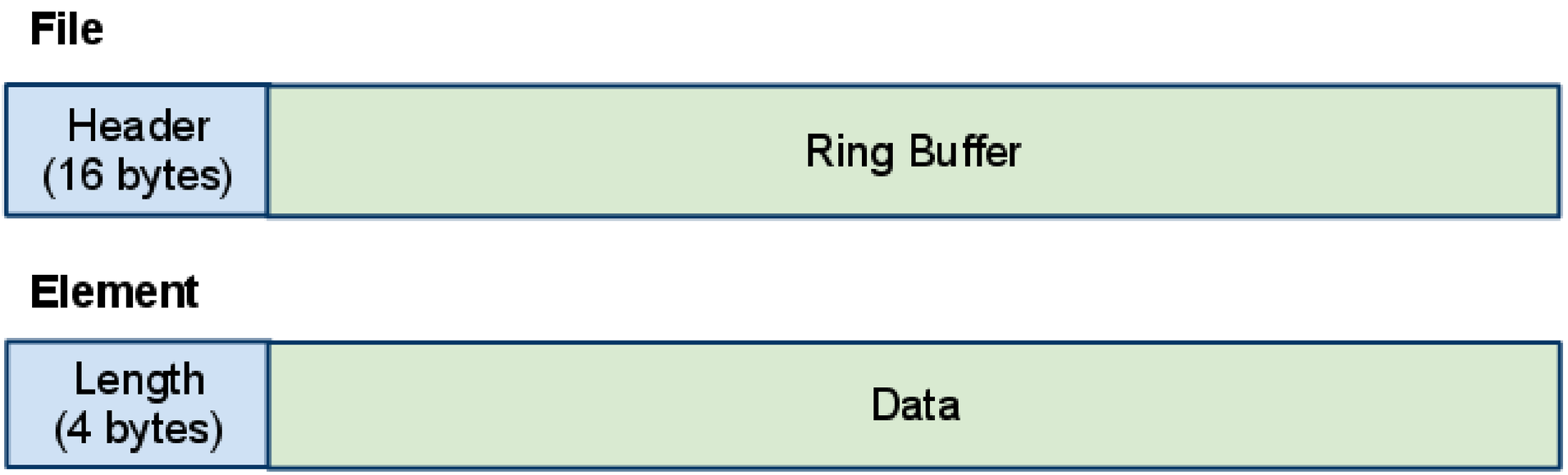
Buffer expansion

> **`file.setLength(oldLength << 1)`**

> Make ring buffer contiguous

> Write header (including file length)

> Update in-memory state



Future Features

> Support file systems without atomic segment writes

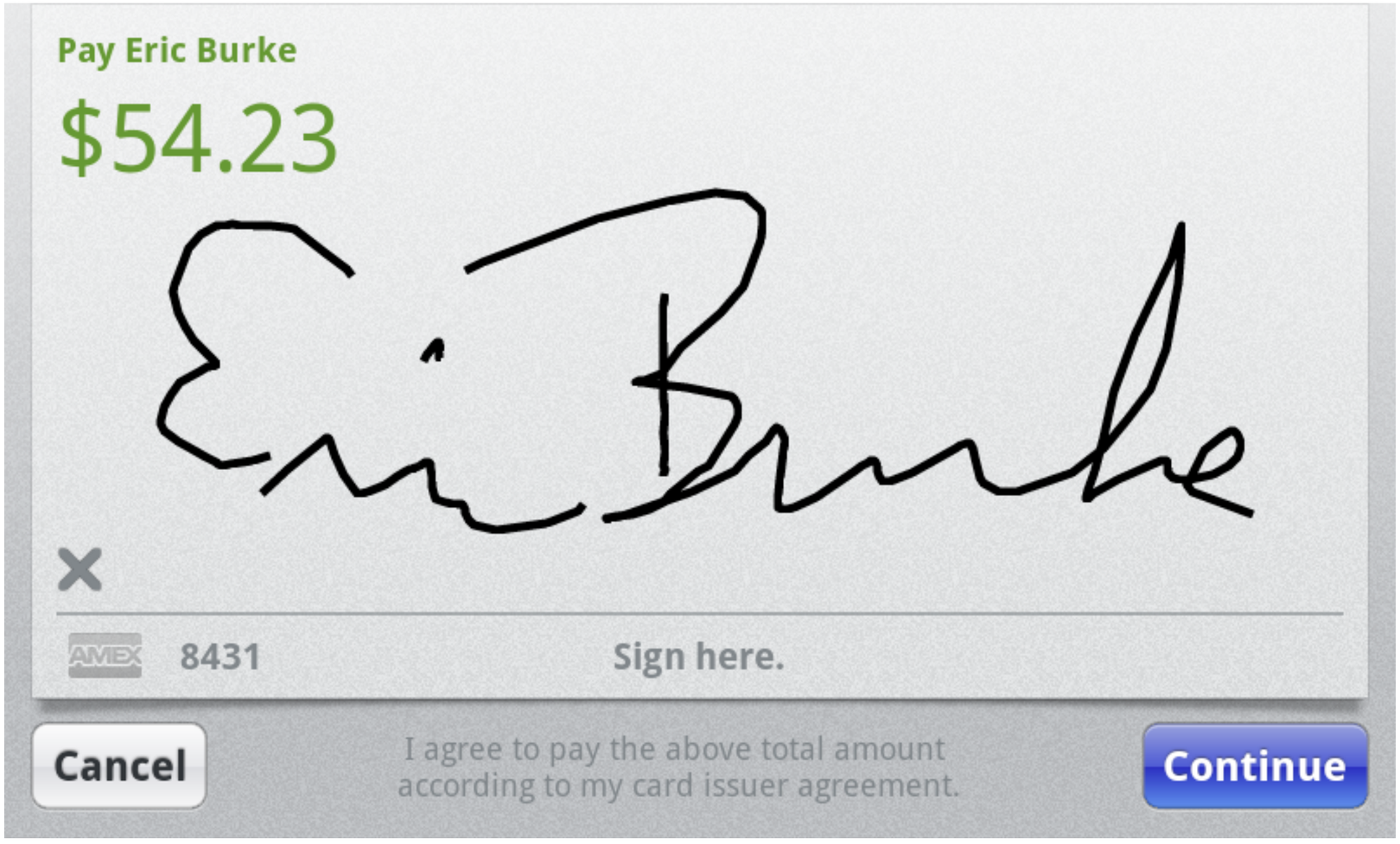
- Rollback journal

> Batch writes

- Optimistic batching
- > 3 orders of magnitude throughput

Etch A Sketch®

Shake to Clear Signature



Using the Accelerometer

```
public class HelloAccelerometer extends Activity
    implements SensorEventListener {

  @Override protected void onResume() {
    super.onResume();

    SensorManager sensorMgr = (SensorManager) getSystemService(
        Context.SENSOR_SERVICE);
    Sensor accelerometer = sensorMgr.getDefaultSensor(
        Sensor.TYPE_ACCELEROMETER);

    sensorMgr.registerListener(this, accelerometer,
        SensorManager.SENSOR_DELAY_GAME);
  }

  public void onSensorChanged(SensorEvent event) {
    float ax = event.values[0];
    float ay = event.values[1];
    float az = event.values[2];
  }
}
```

Accelerometer Values

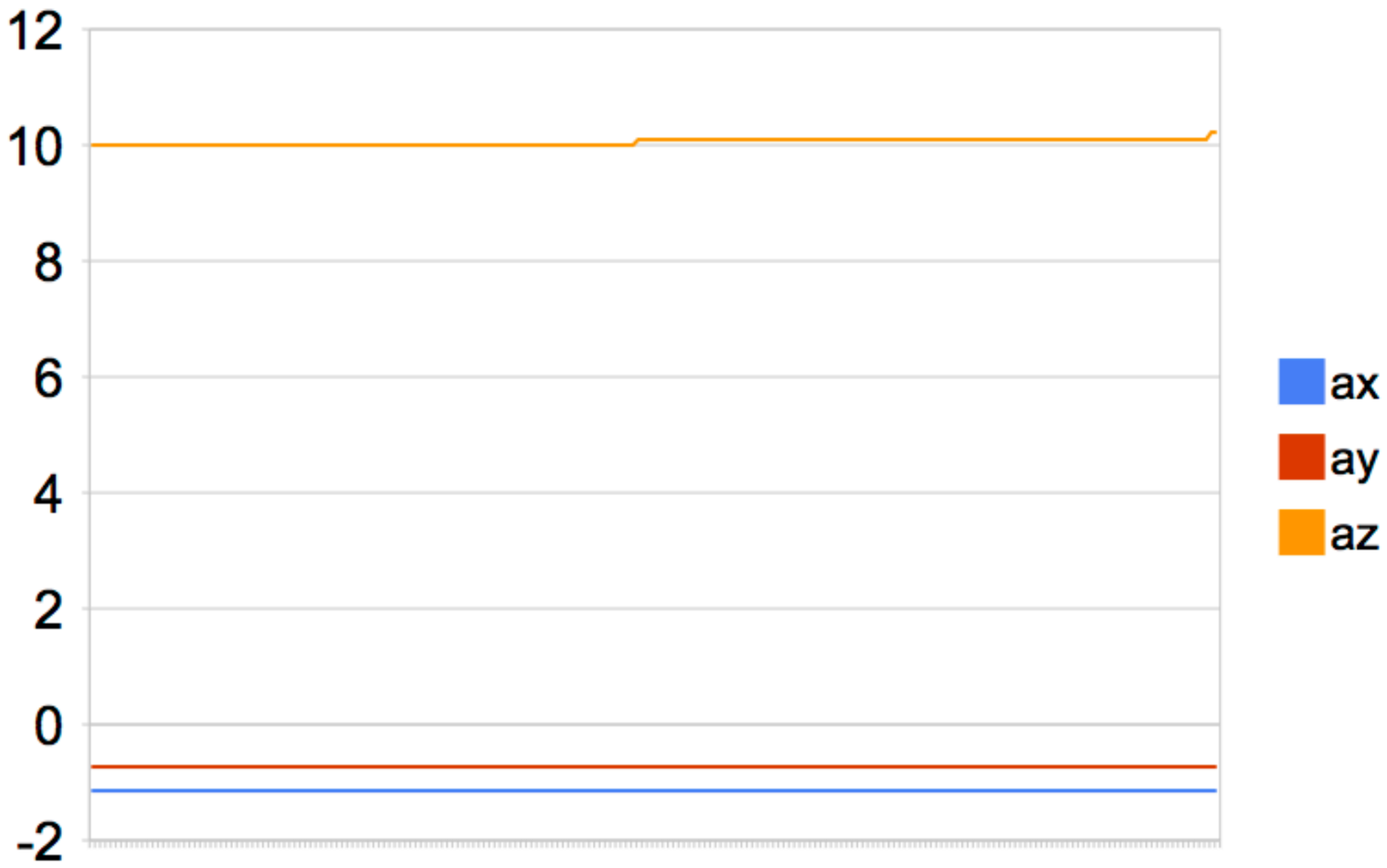
> x, y, and z acceleration

> Units are m/s^2

> Acceleration applied to device *minus force of gravity*

> When flat on a table, Z accel = +9.81 (0 - -9.81)

Device at Rest



Magnitude (Pythagorean)

```
public class Magnitude extends Activity
    implements SensorEventListener {

  public void onSensorChanged(SensorEvent event) {
    float ax = event.values[0];
    float ay = event.values[1];
    float az = event.values[2];

    double magnitude = Math.sqrt(ax * ax + ay * ay + az * az);
    }
}
```

Magnitude Graph

Threshold

Data Rates Vary by Device

	NORMAL	UI	GAME	FASTEST
Dell Streak	47	47	47	47
LG Ally	5	5	5	5
Motorola Backflip	89	89	89	89
Samsung Epic 4G	5	10	19	91
HTC Desire	43	43	43	43

Solution: Variable Size Window

> Did the magnitude exceed the threshold?

> Store true/false readings in a queue

> Queue holds readings from last 500ms

> When 75% of readings are true, shake

ShakeDetector

```
public class ShakeDetector {
  public ShakeDetector(Listener listener) {
    ...
  }

  public void start(SensorManager sensorMgr) {
    ...
  }

  public void stop() {
    ...
  }

  /** Listens for shakes. */
  public interface Listener {
    /** Called on the main thread when the device is shaken. */
    void hearShake();
  }
}
```

Using ShakeDetector

```
public class ShakeDemo extends Activity implements
ShakeDetector.Listener {

  private ShakeDetector shakeDetector = new ShakeDetector(this);

  @Override protected void onResume() {
    super.onResume();

    SensorManager sensorMgr = (SensorManager) getSystemService(
        Context.SENSOR_SERVICE);
    shakeDetector.start(sensorMgr);
  }

  @Override protected void onPause() {
    shakeDetector.stop();
  }

  public void hearShake() {
    // The phone was shaking...
  }
}
```

`RestAdapter`

> Makes RESTful clients a breeze

> Currently supports JSON responses

> All user code runs in main thread

Example

```
public interface AccountService {
  @Path("login")
  void logIn(
      @Named("email") String email,
      @Named("password") String password,
      Callback<LoginResponse> callback);
}
```

`ServerCall`

> UI handler for server calls

> Handles all dialogs

- Progress
- Operation failed
- Network unavailable
- Server unavailable
- Unexpected error

> Supports retries

Examples

> Login

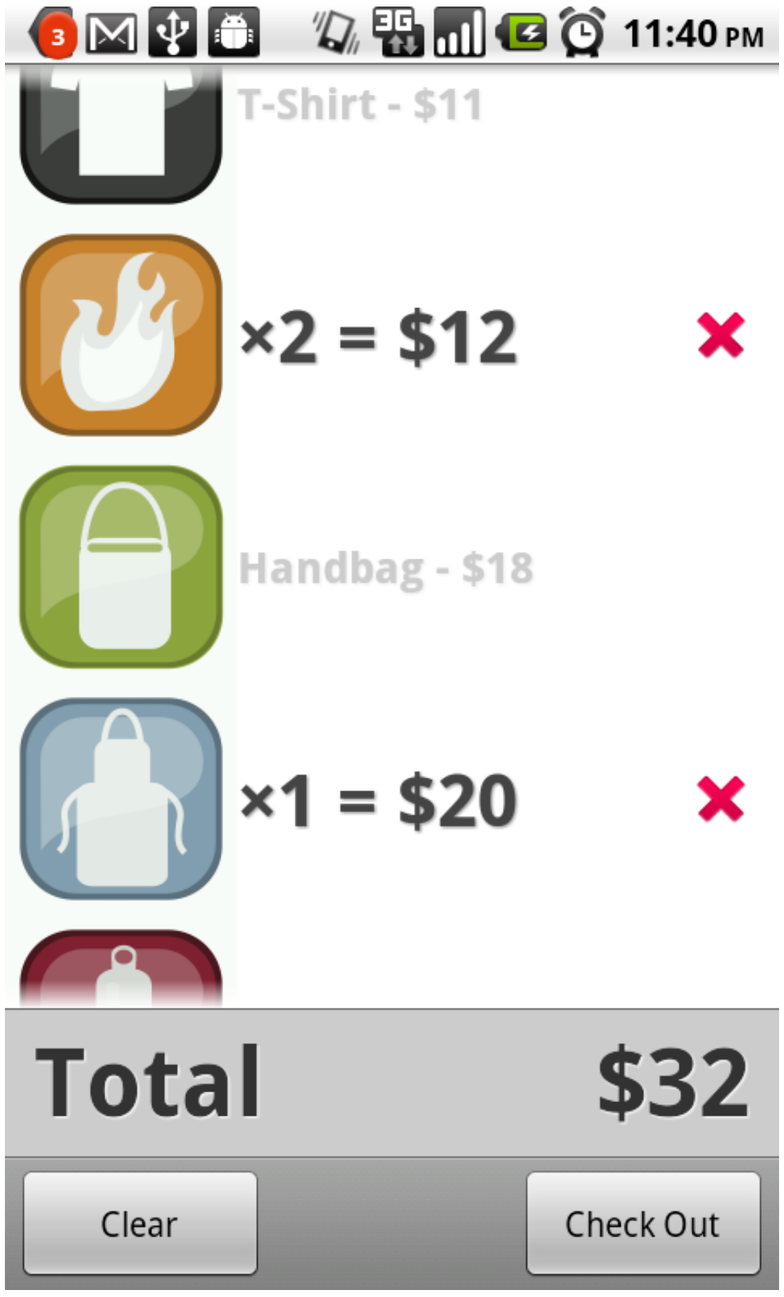
> Signup

> Authorization

Example

```
public class LoginActivity extends SquareActivity {
  @Inject Session session;
  private Login login;

  @Override protected void onCreate(Bundle state) {
    super.onCreate(state);
    login = new Login(session);
    ...
  }

  public void logIn() {
    login.call();
  }
  ...
  class Login extends ServerCall {
    private final Session session;
    @Inject private Login(Session session) {
      super("Logging in...", "Login failed.");
      this.session = session;
      manageWith(LoginActivity.this);
    }
    @Override protected void callServer(Callback<SimpleResponse> callback) {
      session.logIn(getEmail(), getPassword(), callback);
    }
    @Override protected void onSuccess() {
      finish();
    }
  }
}
```

Point-of-Sale API



Example

```
public class TwoCents extends Activity {
  @Override public void onCreate(Bundle state) {
    super.onCreate(state);

    Square square = new Square(this);
    if (square.installationStatus()
        != Square.InstallationStatus.AVAILABLE) {
      square.requestInstallation();
    } else {
      LineItem advice = new LineItem.Builder()
          .price(2, Currency.USD) // 2 cents
          .description("Advice")
          .build();
      square.squareUp(Bill.containing(advice));
    }
  }
}
```

Thank You!

> **http://squareup.com/**

> **http://github.com/square/retrofit**

> We're hiring!

Example

```
public class TwoCents extends Activity {
  @Override public void onCreate(Bundle state) {
    super.onCreate(state);

    Square square = new Square(this);
    if (square.installationStatus()
        != Square.InstallationStatus.AVAILABLE) {
      square.requestInstallation();
    } else {
      LineItem advice = new LineItem.Builder()
          .price(2, Currency.USD) // 2 cents
          .description("Advice")
          .build();
      square.squareUp(Bill.containing(advice));
    }
  }
}
```