Google™ 09 I O

Coding for Life--Battery Life, That Is

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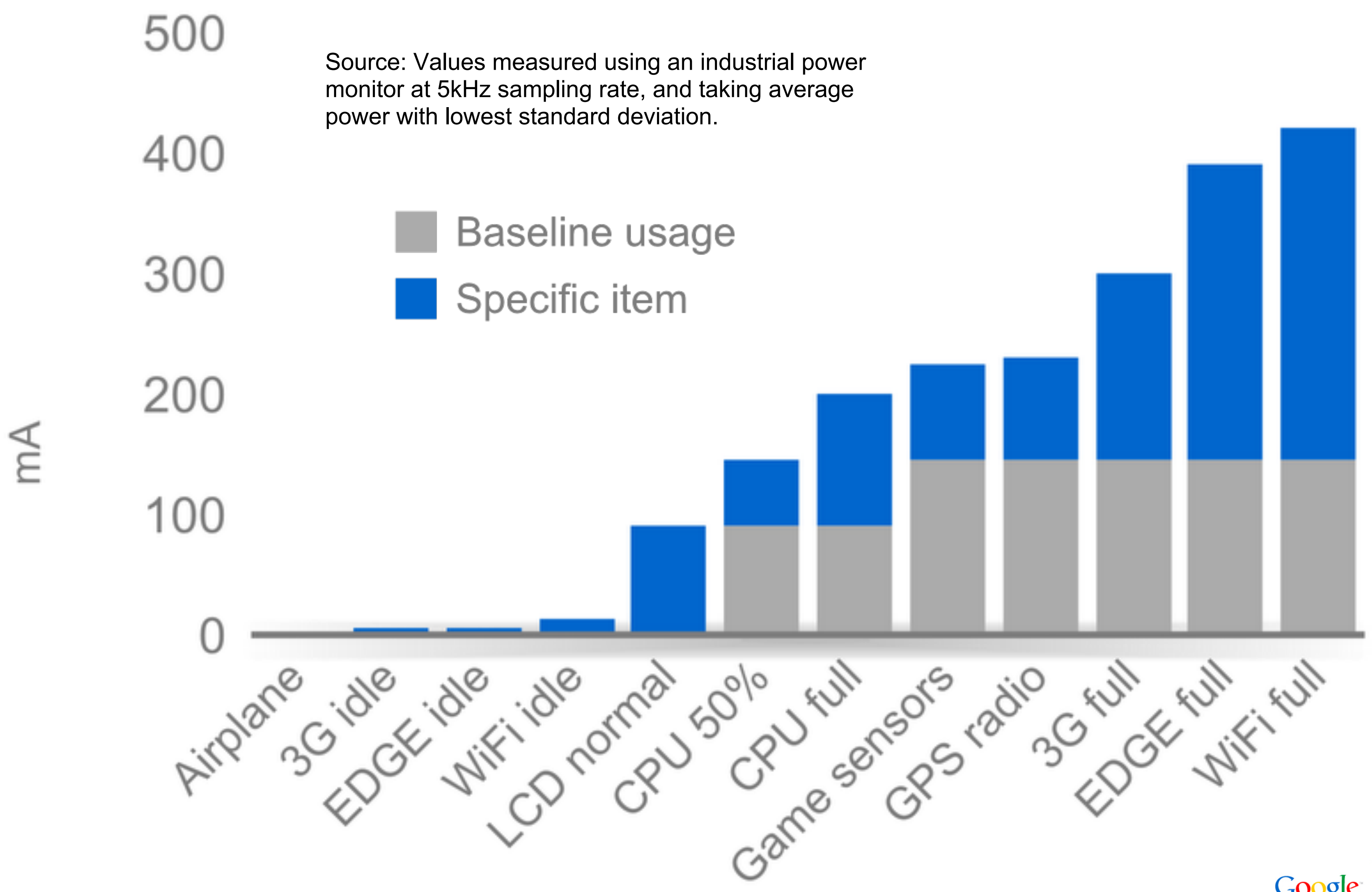
Why does this matter?

- Phones primarily run on battery power, and each device has a "**battery budget**"
    - When it's gone, it's gone
    - Apps need to work together to be good citizens of that shared resource
    - Current measured in mA, battery capacity in mAh

- HTC Dream: **1150mAh**
- HTC Magic: **1350mAh**
- Samsung I7500: **1500mAh**
- Asus Eee PC: **5800mAh**

Where does it all go?



Where does it all go?

- How do these numbers add up in real life?
  - Watching YouTube: 340mA = **3.4 hours**
  - Browsing 3G web: 225mA = **5 hours**
  - Typical usage: 42mA average = **32 hours**
  - EDGE completely idle: 5mA = **9.5 days**
  - Airplane mode idle: 2mA = **24 days**

What costs the most?

- **Waking up in the background** when the phone would otherwise be sleeping
  - App wakes up every 10 minutes to update
  - Takes about 8 seconds to update, 350mA
- Cost during a given hour:
  - 3600 seconds * 5mA = **5mAh resting**
  - 6 times * 8 sec * 350 mA = **4.6mAh updating**
- Just *one app* waking up can trigger cascade

What costs the most?

- **Bulk data transfer** such as a 6MB song:
    - EDGE (90kbps): 300mA * 9.1 min = **45 mAh**
    - 3G (300kbps): 210mA * 2.7 min = **9.5 mAh**
    - WiFi (1Mbps): 330mA * 48 sec = **4.4 mAh**
- Moving between cells/networks
    - Radio ramps up to associate with new cell
    - BroadcastIntents fired across system
- Parsing textual data, regex without JIT

How can we do better?

Networking

How can we do better?

Networking

- **Check network connection**, wait for 3G or WiFi

```
ConnectivityManager mConnectivity;
TelephonyManager mTelephony;

// Skip if no connection, or background data disabled
NetworkInfo info = mConnectivity.getActiveNetworkInfo();
if (info == null ||
        !mConnectivity.getBackgroundDataSetting()) {
    return false;
}
```

How can we do better?

Networking

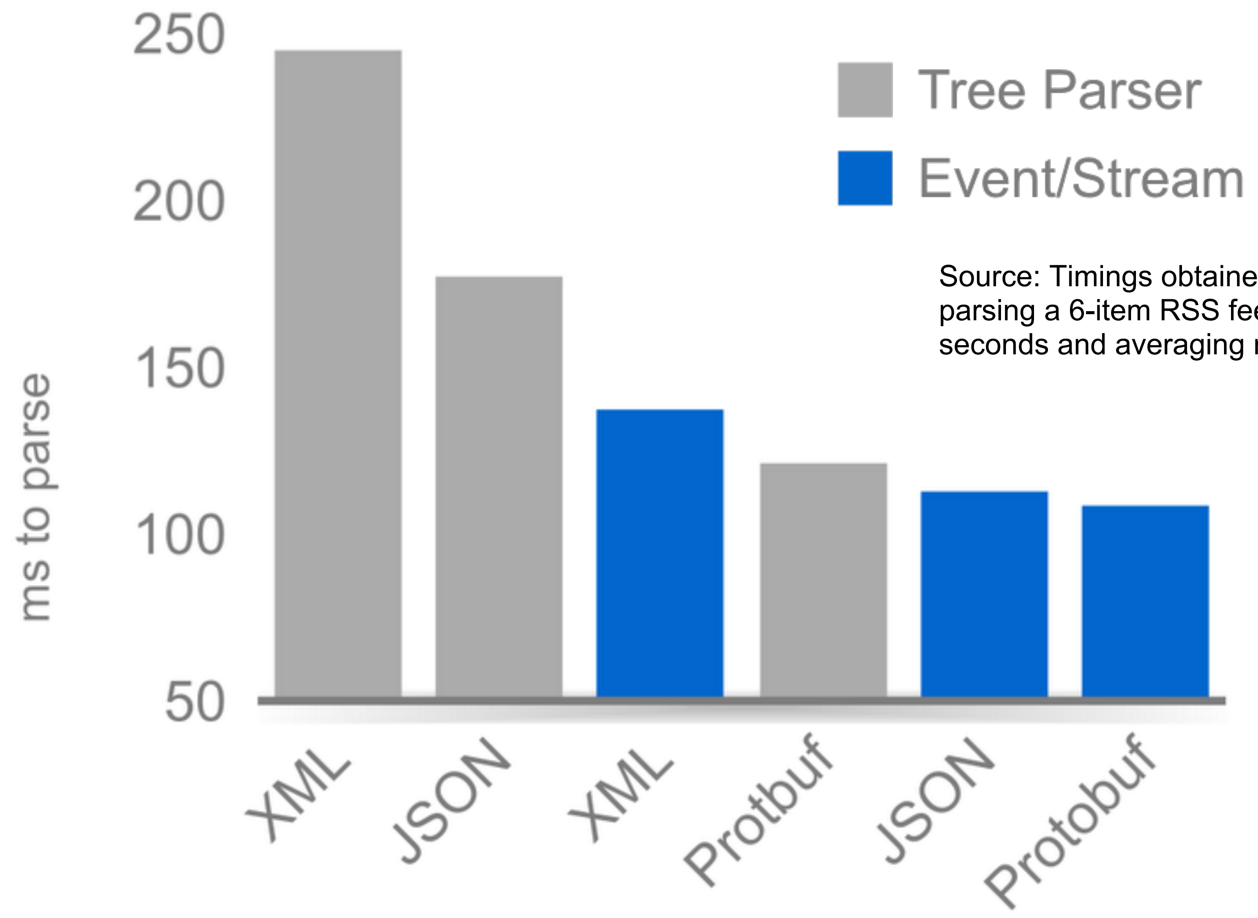
- **Check network connection**, wait for 3G or WiFi

```
// Only update if WiFi or 3G is connected and not roaming
int netType = info.getType();
int netSubtype = info.getSubtype();

if (netType == ConnectivityManager.TYPE_WIFI) {
    return info.isConnected();
} else if (netType == ConnectivityManager.TYPE_MOBILE
        && netSubtype == TelephonyManager.NETWORK_TYPE_UMTS
        && !mTelephony.isNetworkRoaming()) {
    return info.isConnected();
} else {
    return false;
}
```

How can we do better?

Networking

- Use an **efficient data format and parser**



Source: Timings obtained by downloading and parsing a 6-item RSS feed repeatedly for 60 seconds and averaging results.

How can we do better?

Networking

- Use an **efficient data format and parser**
    - Use "stream" parsers instead of tree parsers
    - Consider binary formats that can easily mix binary and text data into a single request
    - Fewer round-trips to server for faster UX

How can we do better?

Networking

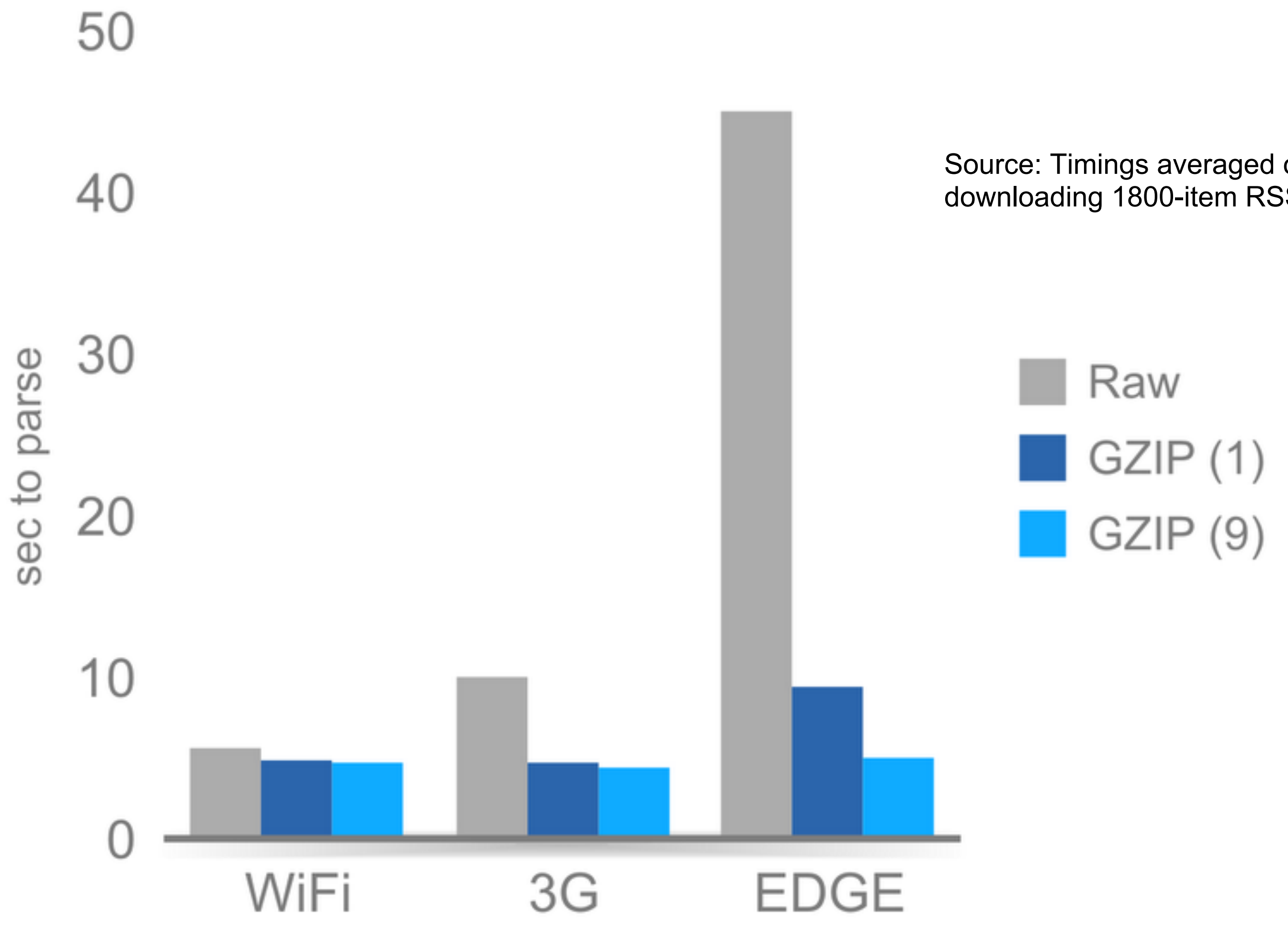
- Use **GZIP for text data** whenever possible
  - Framework GZIP libs go *directly to native code* , and are perfect for streams

```
import java.util.zip.GZIPInputStream;

HttpGet request =
    new HttpGet("http://example.com/gzipcontent");
HttpResponse resp =
    new DefaultHttpClient().execute(request);
HttpEntity entity = response.getEntity();
InputStream compressed = entity.getContent();
InputStream rawData = new GZIPInputStream(compressed);
```

How can we do better?

Networking

- Use **GZIP for text data** whenever possible



Source: Timings averaged over multiple trials of downloading 1800-item RSS feed of textual data.

How can we do better?

Foreground apps

How can we do better?

Foreground apps

- **Wakelocks are costly** if forgotten
  - Pick the lowest level possible, and use specific timeouts to work around unforseen bugs
  - Consider using android:keepScreenOn to ensure correctness

```
<LinearLayout
    android:orientation="vertical"
    android:layout_width="fill_parent"
    android:layout_height="fill_parent"
    android:keepScreenOn="true">
```

How can we do better?

Foreground apps

- **Recycle Java objects**, especially complex objects
  - Yes, we have a GC, but usually better to just *create less garbage* that it has to clean up
    - XmlPullParserFactory and BitmapFactory
    - Matcher.reset(newString) for regex
    - StringBuilder.setLength(0)
  - Watch for synchronization issues, but can be safe when driven by UI thread
  - Recycling strategies are used heavily in ListView

How can we do better?

Foreground apps

- **Use coarse network location**, it's much cheaper
    - GPS: 25 seconds * 140mA = **1mAh**
    - Network: 2 seconds * 180mA = **0.1mAh**
- 1.5 uses AGPS when network available
- GPS time-to-fix varies wildly based on environment, and desired accuracy, and might outright fail
    - Just like wake-locks, location updates can continue after onPause(), so make sure to unregister
    - If all apps unregister correctly, user can leave GPS enabled in Settings

How can we do better?

Foreground apps

- Floating point math is expensive
    - Using microdegrees when doing bulk geographic math

```
// GeoPoint returns value 37392778, -122041944
double lat = GeoPoint.getLatitudeE6() / 1E6;
double lon = GeoPoint.getLongitudeE6() / 1E6;
```

- Caching values when doing DPI work with DisplayMetrics

```
float density =
        getResources().getDisplayMetrics().density;
int actualWidth =
        (int)(bitmap.getWidth() * density);
```

How can we do better?

Foreground apps

- Accelerometer/magnetic sensors
  - Normal: 10mA (used for orientation detection)
  - UI: 15mA (about 1 per second)
  - Game: 80mA
  - Fastest: 90mA
- Same cost for accelerometer, magnetic, orientation sensors on HTC Dream

How can we do better?

Background apps

How can we do better?
Background apps

- Services should be short-lived; these aren't daemons
    - Each process costs 2MB and risks being killed/restarted as foreground apps need memory
    - Otherwise, keep memory usage low so you're not the first target
- Trigger wake-up through AlarmManager or with <receiver> manifest elements
    - stopSelf() when finished

How can we do better?

Background apps

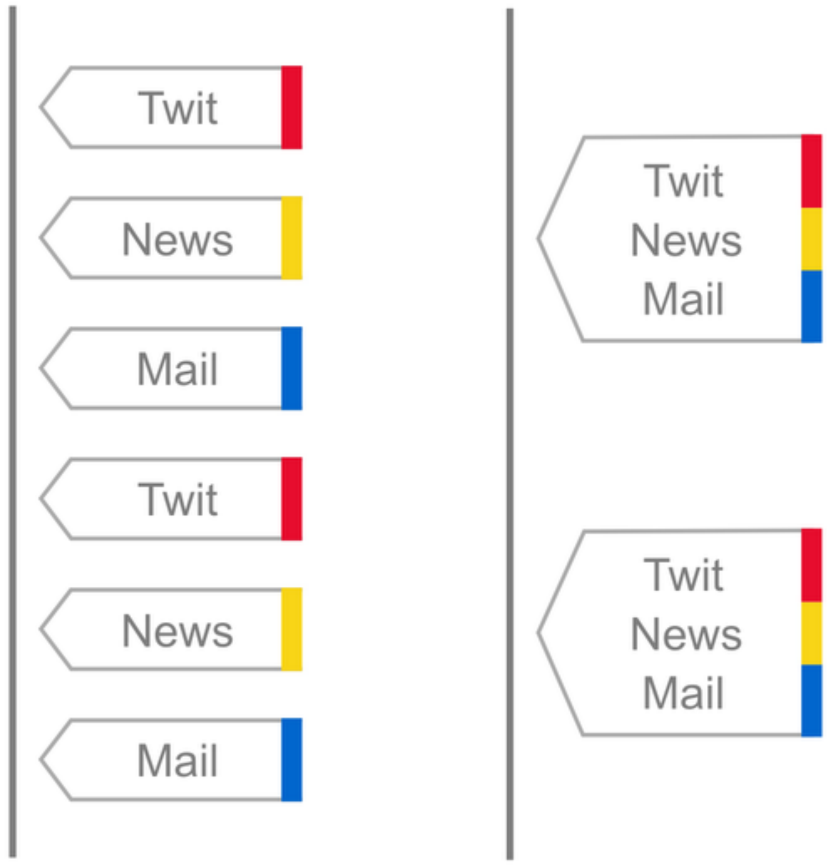
- Start service using AlarmManager
    - Use the _WAKEUP flags with caution
    - App that updates every 30 minutes, but only when device is *already awake*

```
AlarmManager am = (AlarmManager)
        context.getSystemService(Context.ALARM_SERVICE);

Intent intent = new Intent(context, MyService.class);
PendingIntent pendingIntent =
        PendingIntent.getService(context, 0, intent, 0);

long interval = DateUtils.MINUTE_IN_MILLIS * 30;
long firstWake = System.currentTimeMillis() + interval;

am.setRepeating(AlarmManager.RTC,
        firstWake, interval, pendingIntent);
```

How can we do better?

Background apps

- Use setInexactRepeating() so the system can bin your update together with others



How can we do better?

Background apps

- Start your service using <receiver> in manifest
  - Intent.ACTION_TIMEZONE_CHANGED
  - ConnectivityManager.CONNECTIVITY_ACTION
  - Intent.ACTION_DEVICE_STORAGE_LOW
  - Intent.ACTION_BATTERY_LOW
  - Intent.ACTION_MEDIA_MOUNTED

```
<receiver android:name=".ConnectivityReceiver">
    <intent-filter>
        <action android:name=
            "android.net.conn.CONNECTIVITY_CHANGE" />
    </intent-filter>
</receiver>
```

How can we do better?
Background apps

- Dynamically enabling/disabling <receiver> components in manifest, especially when no-ops

```
<receiver android:name=".ConnectivityReceiver"
    android:enabled="false">
    ...
</receiver>
```

```
ComponentName receiver = new ComponentName(context,
        ConnectivityReceiver.class);
PackageManager pm = context.getPackageManager();
pm.setComponentEnabledSetting(receiver,
        PackageManager.COMPONENT_ENABLED_STATE_ENABLED,
        PackageManager.DONT_KILL_APP);
```

How can we do better?

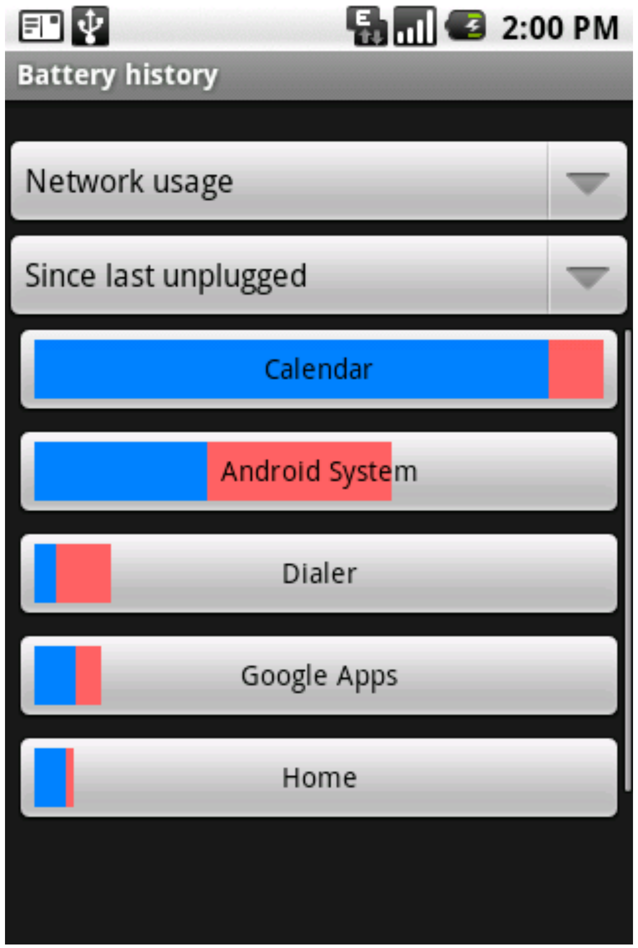
Background apps

- Checking current battery and network state before running a full update

```
public void onCreate() {
    // Register for sticky broadcast and send default
    registerReceiver(mReceiver, mFilter);
    mHandler.sendEmptyMessageDelayed(MSG_BATT, 1000);
}

IntentFilter mFilter =
        new IntentFilter(Intent.ACTION_BATTERY_CHANGED);

BroadcastReceiver mReceiver = new BroadcastReceiver() {
    public void onReceive(Context context, Intent intent) {
        // Found sticky broadcast, so trigger update
        unregisterReceiver(mReceiver);
        mHandler.removeMessages(MSG_BATT);
        mHandler.obtainMessage(MSG_BATT, intent).sendToTarget();
    }
};
```

Beyond 1.5

Users will be watching!



- SpareParts has "Battery history"
    - 1.5 is already keeping stats on which apps are using CPU, network, wakelocks
    - Simplified version coming in future, and users will uninstall apps that abuse battery
- Consider giving users options for battery usage, like update intervals, and check the "no background data" flag

Takeaways

- Use an efficient parser and GZIP to make best use of network and CPU resources
- Services that sleep or poll are bad, use <receiver> and AlarmManager instead
    - Disable manifest elements when no-op
    - Wake up along with everyone else (inexact alarms)
- Wait for better network/battery for bulk transfers
- Give users choices about background behavior

Q & A

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