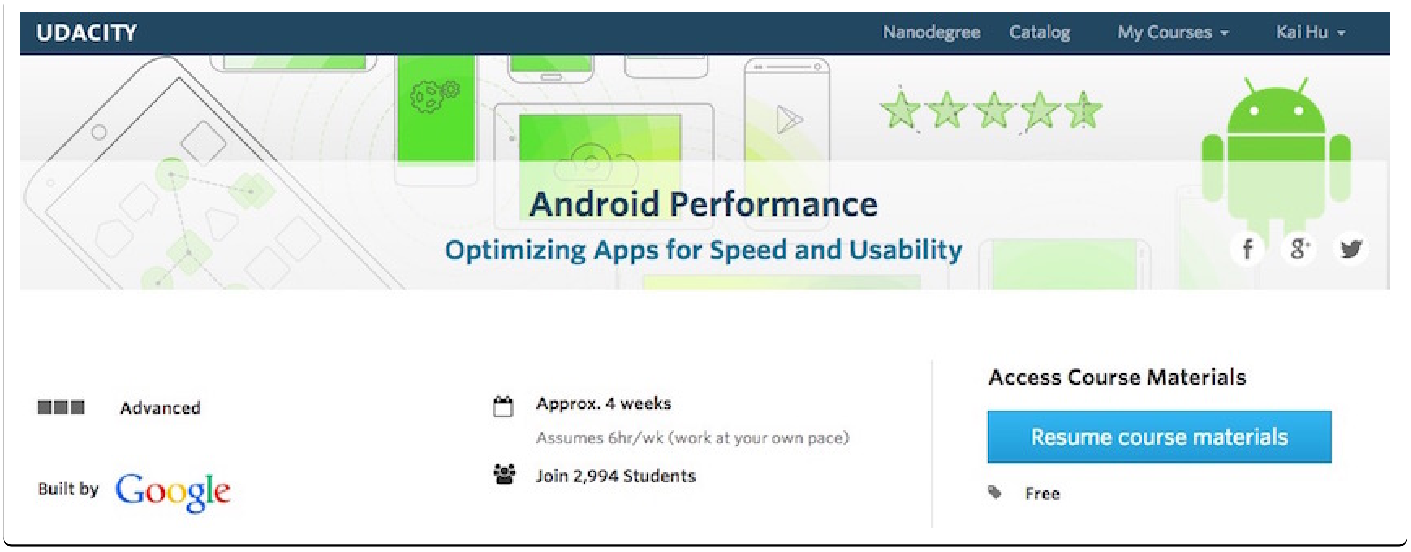
APR 12TH, 2015 | COMMENTS

Android性能优化之电量篇

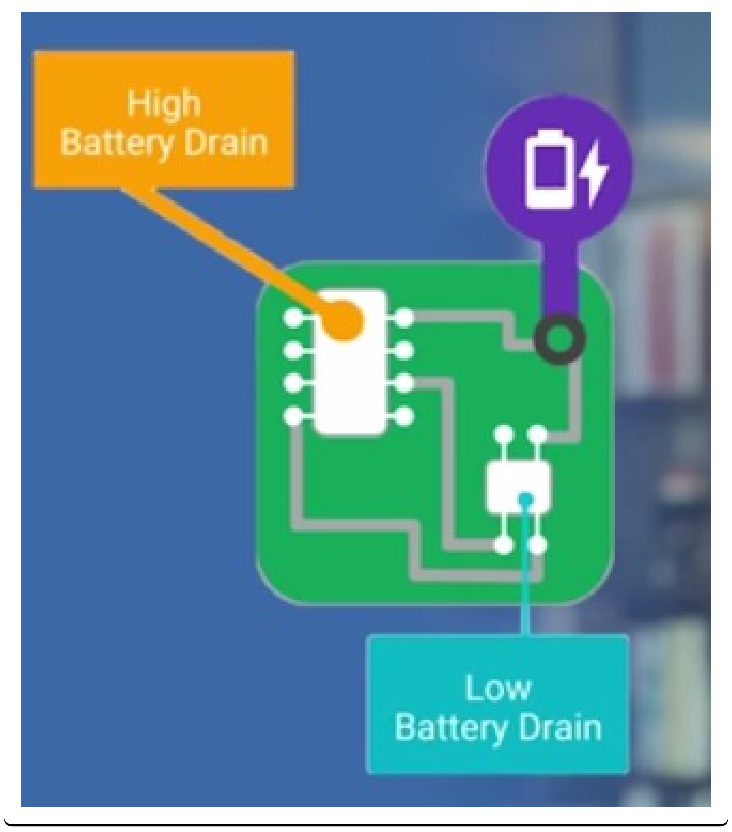


Google近期在Udacity上发布了Android性能优化的在线课程，分别从渲染，运算与内存，电量几个方面介绍了如何去优化性能，这些课程是Google之前在Youtube上发布的Android性能优化典范专题课程的细化与补充。

下面是电量篇章的学习笔记，部分内容与前面的性能优化典范有重合，欢迎大家一起学习交流！

1)Understanding Battery Drain

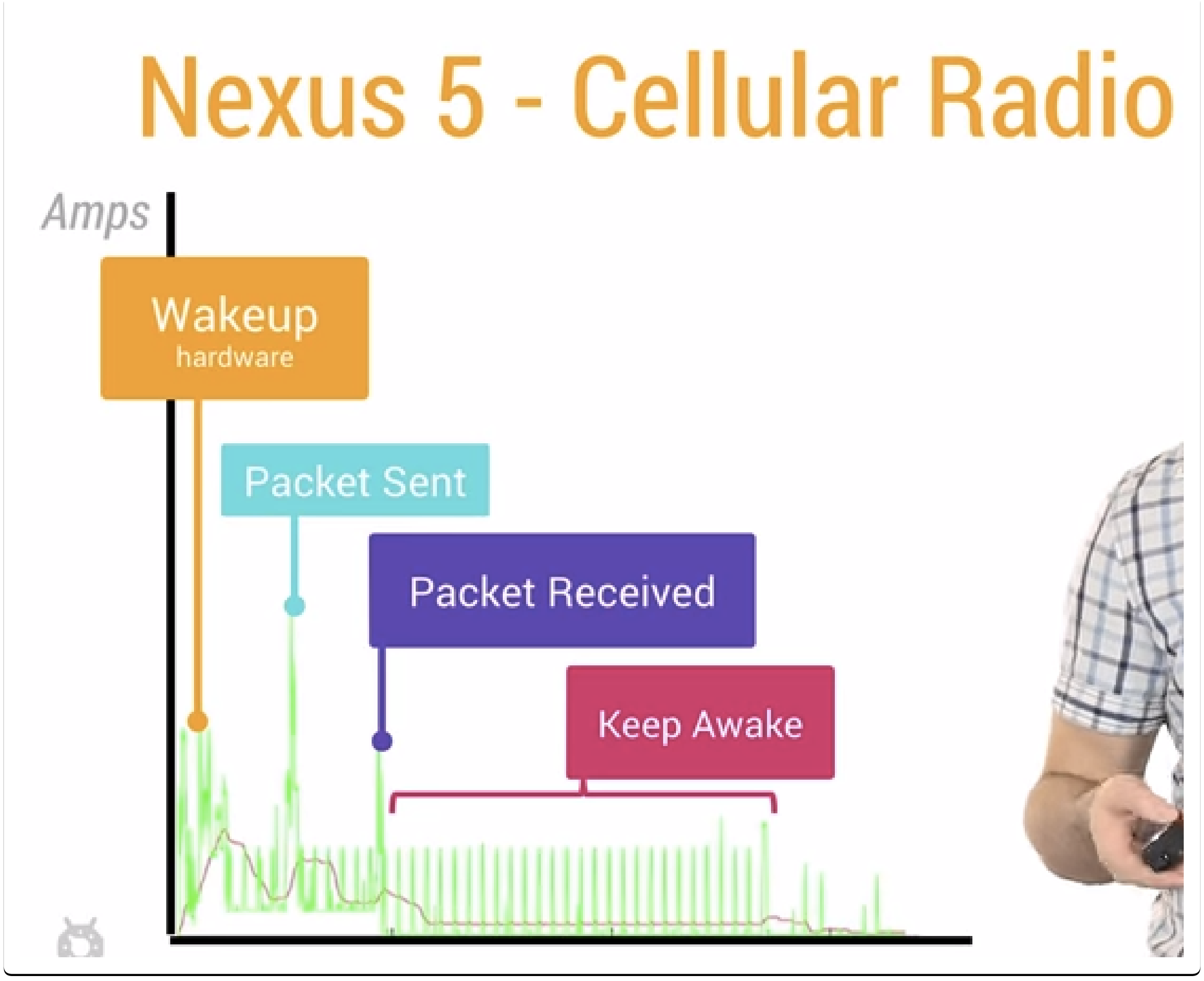
手机各个硬件模块的耗电量是不一样的，有些模块非常耗电，而有些模块则相对显得耗电量小很多。



电量消耗的计算与统计是一件麻烦而且矛盾的事情，记录电量消耗本身也是一个费电量的事情。唯一可行的方案是使用第三方监测电量的设备，这样才能够获取到真实的电量消耗。

当设备处于待机状态时消耗的电量是极少的，以N5为例，打开飞行模式，可以待机接近1个月。可是点亮屏幕，硬件各个模块就需要开始工作，这会需要消耗很多电量。

使用WakeLock或者JobScheduler唤醒设备处理定时的任务之后，一定要及时让设备回到初始状态。每次唤醒蜂窝信号进行数据传递，都会消耗很多电量，它比WiFi等操作更加的耗电。



2)Battery Historian

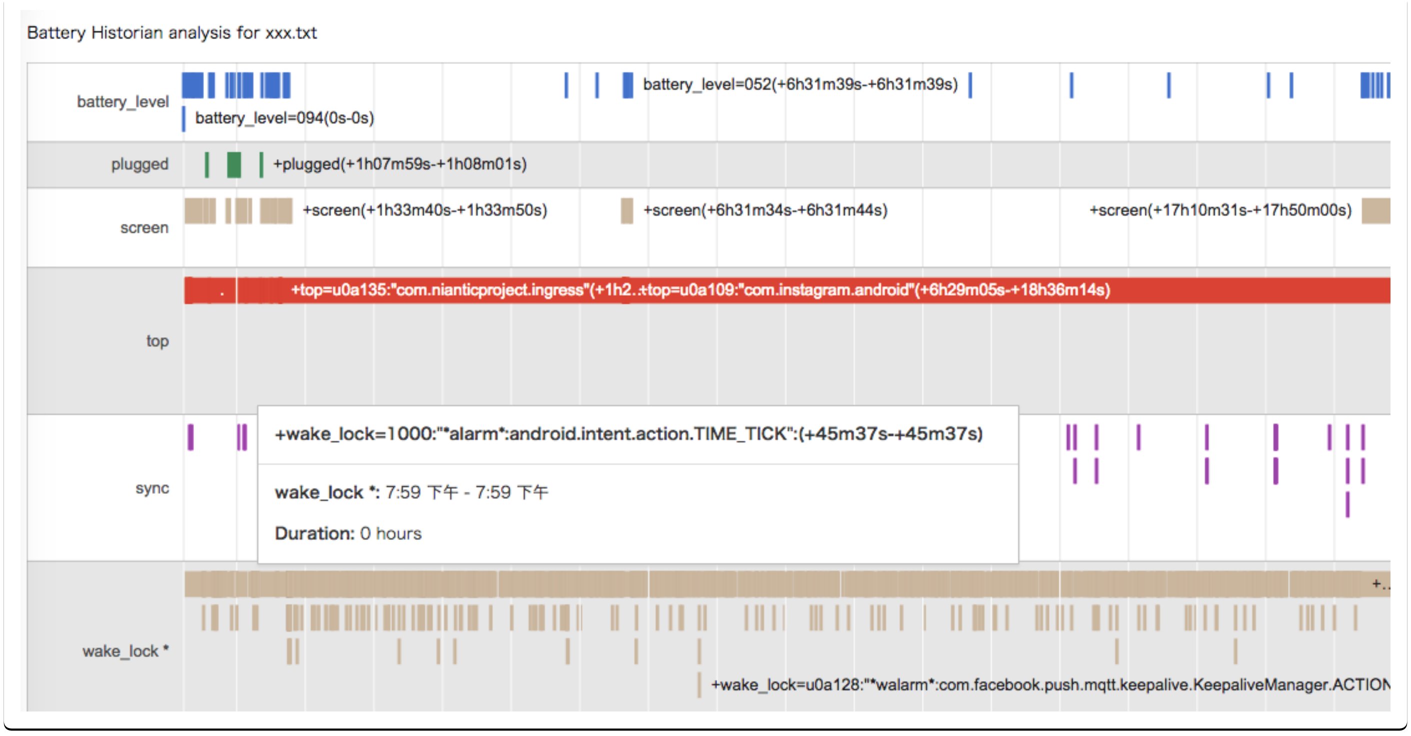
Battery Historian是Android 5.0开始引入的新API。通过下面的指令，可以得到设备上的电量消耗信息：

```
$ adb shell dumpsys batterystats > xxx.txt  //得到整个设备的电量消耗信息
$ adb shell dumpsys batterystats > com.package.name > xxx.txt //得到指定app相关的
```

得到了原始的电量消耗数据之后，我们需要通过Google编写的一个python脚本把数据信息转换成可读性更好的html文件：

```
$ python historian.py xxx.txt > xxx.html
```

打开这个转换过后的html文件，可以看到类似TraceView生成的列表数据，这里的数据信息量很大，这里就不展开了。


Battery Historian analysis for xxx.txt
battery_level
battery_level=052(+6h31m39s-+6h31m39s)
battery_level=094(0s-0s)
plugged
+plugged(+1h07m59s-+1h08m01s)
screen
+screen(+1h33m40s-+1h33m50s)
+screen(+6h31m34s-+6h31m44s)
+screen(+17h10m31s-+17h50m00s)
top
+top=u0a135:"com.nianticproject.ingress"(+1h2..+top=u0a109:"com.instagram.android"(+6h29m05s-+18h36m14s)
sync
wake_lock *
+wake_lock=u0a128:"*walarm*:com.facebook.push.mqtt.keepalive.KeepaliveManager.ACTION

+wake_lock=1000:"*alarm*:android.intent.action.TIME_TICK":(+45m37s-+45m37s)

wake_lock *: 7:59 下午 - 7:59 下午

Duration: 0 hours

3)Track Battery Status & Battery Manager

我们可以通过下面的代码来获取手机的当前充电状态:

```
// It is very easy to subscribe to changes to the battery state, but you can ge
// state by simply passing null in as your receiver.  Nifty, isn't that?
IntentFilter filter = new IntentFilter(Intent.ACTION_BATTERY_CHANGED);
Intent batteryStatus = this.registerReceiver(null, filter);
int chargePlug = batteryStatus.getIntExtra(BatteryManager.EXTRA_PLUGGED, -1);
boolean acCharge = (chargePlug == BatteryManager.BATTERY_PLUGGED_AC);
if (acCharge) {
    Log.v(LOG_TAG,“The phone is charging!”);
}
```

在上面的例子演示了如何立即获取到手机的充电状态，得到充电状态信息之后，我们可以有针对性的对部分代码做优化。比如我们可以判断只有当前手机为AC充电状态时 才去执行一些非常耗电的操作。

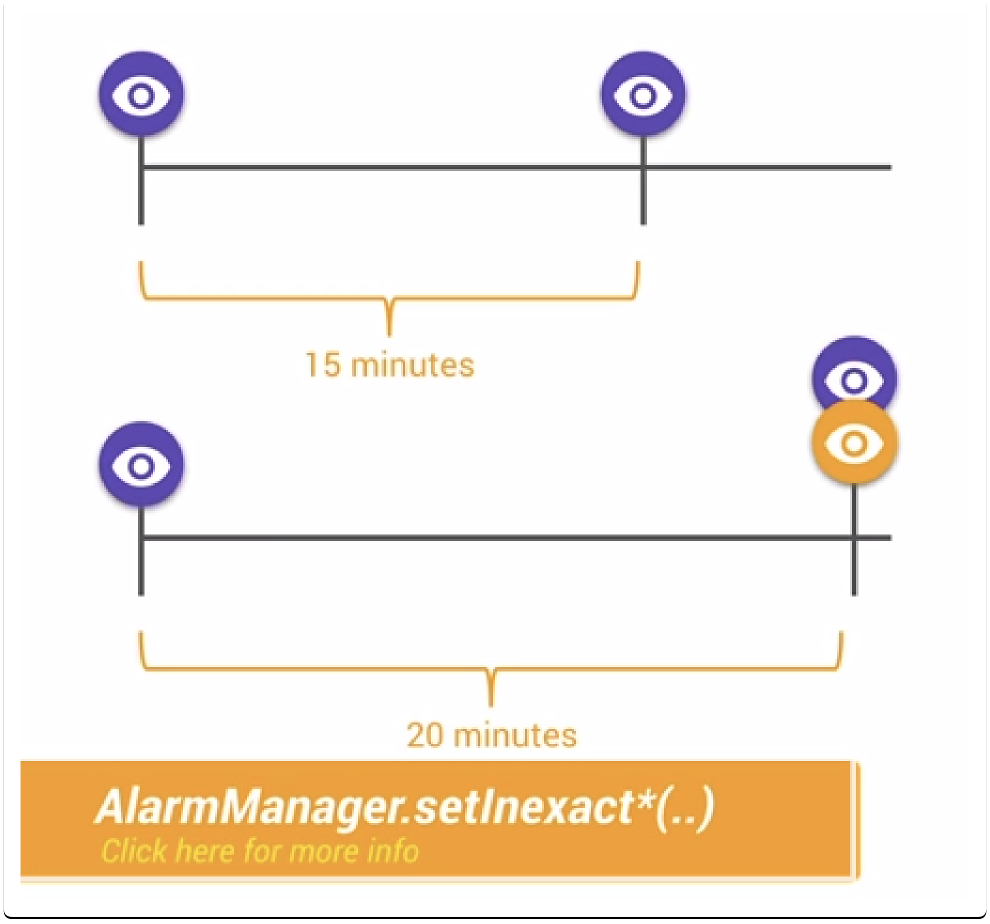
```
/**
 * This method checks for power by comparing the current battery state against
 * plugged in states. In this case, a device may be considered plugged in eith
 * wireless charge. (Wireless charge was introduced in API Level 17.)
 */
private boolean checkForPower() {
    // It is very easy to subscribe to changes to the battery state, but you c
    // state by simply passing null in as your receiver.  Nifty, isn't that?
    IntentFilter filter = new IntentFilter(Intent.ACTION_BATTERY_CHANGED);
    Intent batteryStatus = this.registerReceiver(null, filter);

    // There are currently three ways a device can be plugged in. We should ch
    int chargePlug = batteryStatus.getIntExtra(BatteryManager.EXTRA_PLUGGED, -
    boolean usbCharge = (chargePlug == BatteryManager.BATTERY_PLUGGED_USB);
    boolean acCharge = (chargePlug == BatteryManager.BATTERY_PLUGGED_AC);
    boolean wirelessCharge = false;
    if (Build.VERSION.SDK_INT >= Build.VERSION_CODES.JELLY_BEAN_MR1) {
        wirelessCharge = (chargePlug == BatteryManager.BATTERY_PLUGGED_WIRELES
    }
    return (usbCharge || acCharge || wirelessCharge);
}
```

4)Wakelock and Battery Drain

高效的保留更多的电量与不断促使用户使用你的App会消耗电量，这是矛盾的选择题。不过我们可以使用一些更好的办法来平衡两者。

假设你的手机里面装了大量的社交类应用，即使手机处于待机状态，也会经常被这些应用唤醒用来检查同步新的数据信息。Android会不断关闭各种硬件来延长手机的待机时间，首先屏幕会逐渐变暗直至关闭，然后CPU进入睡眠，这一切操作都是为了节约宝贵的电量资源。但是即使在这种睡眠状态下，大多数应用还是会尝试进行工作，他们将不断的唤醒手机。一个最简单的唤醒手机的方法是使用PowerManager.WakeLock的API来保持CPU工作并防止屏幕变暗关闭。这使得手机可以被唤醒，执行工作，然后回到睡眠状态。知道如何获取WakeLock是简单的，可是及时释放WakeLock也是非常重要的，不恰当的使用WakeLock会导致严重错误。例如网络请求的数据返回时间不确定，导致本来只需要10s的事情一直等待了1个小时，这样会使得电量白白浪费了。这也是为何使用带超时参数的wakelock.acquice()方法是很关键的。

但是仅仅设置超时并不足够解决问题，例如设置多长的超时比较合适？什么时候进行重试等等？解决上面的问题，正确的方式可能是使用非精准定时器。通常情况下，我们会设定一个时间进行某个操作，但是动态修改这个时间也许会更好。例如，如果有另外一个程序需要比你设定的时间晚5分钟唤醒，最好能够等到那个时候，两个任务捆绑一起同时进行，这就是非精确定时器的核心工作原理。我们可以定制计划的任务，可是系统如果检测到一个更好的时间，它可以推迟你的任务，以节省电量消耗。



这正是JobScheduler API所做的事情。它会根据当前的情况与任务，组合出理想的唤醒时间，例如等到正在充电或者连接到WiFi的时候，或者集中任务一起执行。我们可以通过这个API实现很多免费的调度算法。

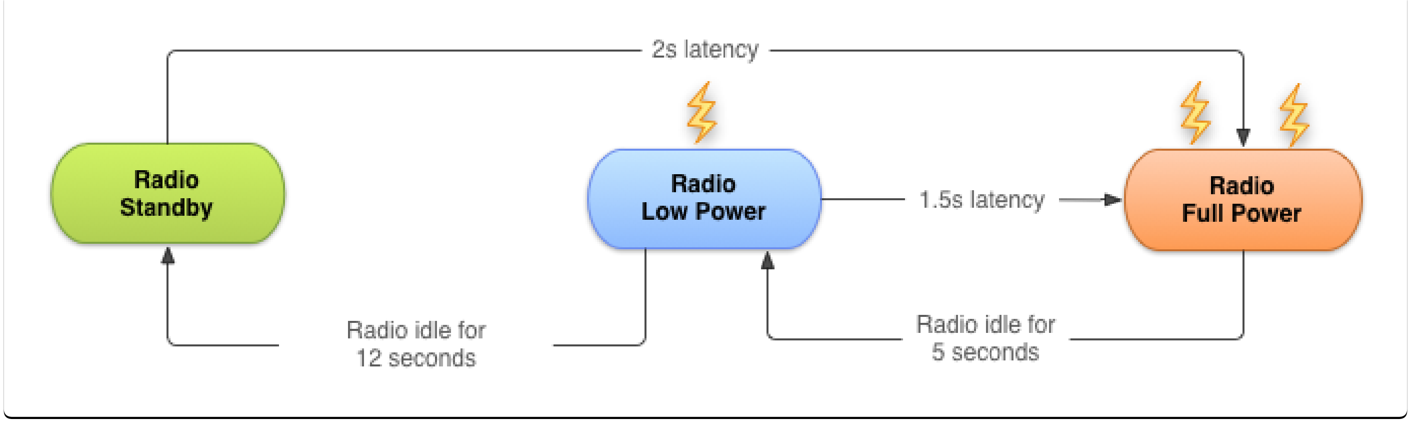
5)Network and Battery Drain

下面内容来自官方Training文档中高效下载章节关于手机(Radio)蜂窝信号对电量消耗的介绍。

通常情况下，使用3G移动网络传输数据，电量的消耗有三种状态：

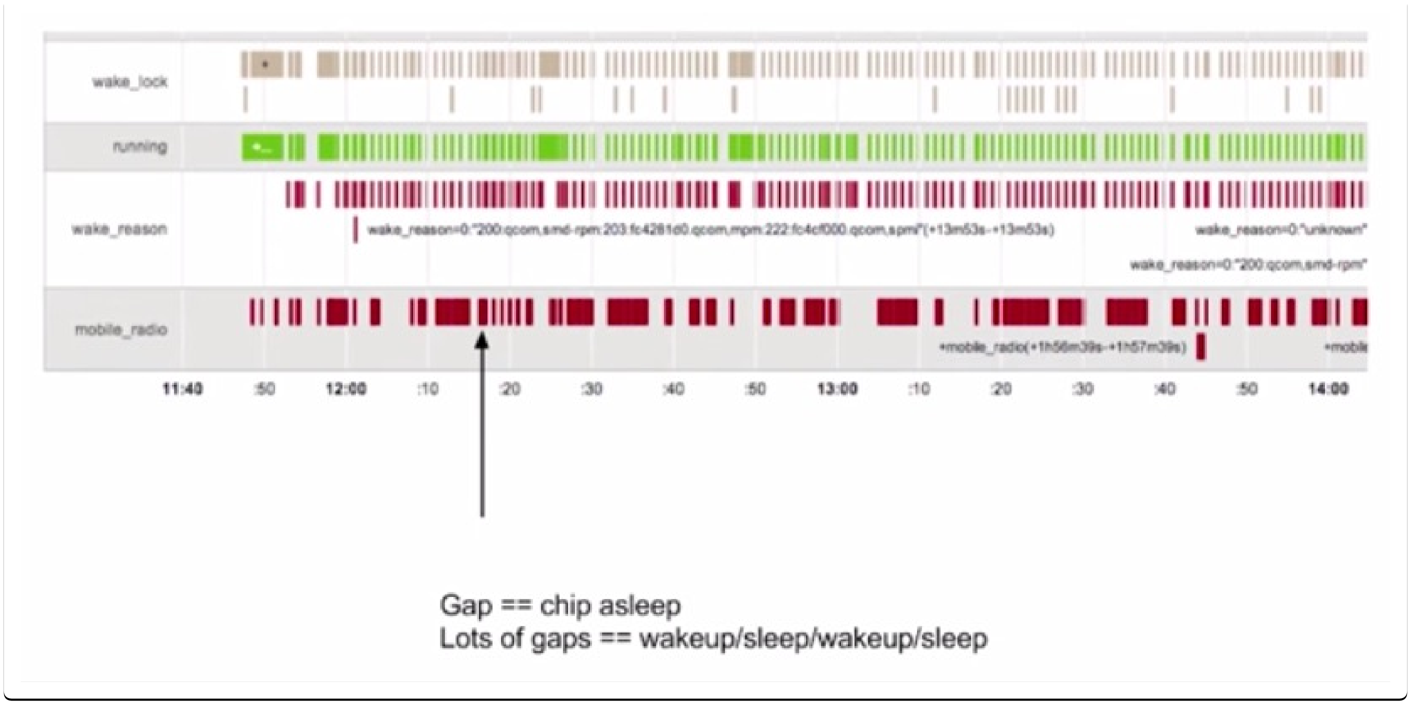
- **Full power**: 能量最高的状态，移动网络连接被激活，允许设备以最大的传输速率进行操作。
- **Low power**: 一种中间状态，对电量的消耗差不多是Full power状态下的50%。
- **Standby**: 最低的状态，没有数据连接需要传输，电量消耗最少。

下图是一个典型的3G Radio State Machine的图示(来自AT&T，详情请点击这里):

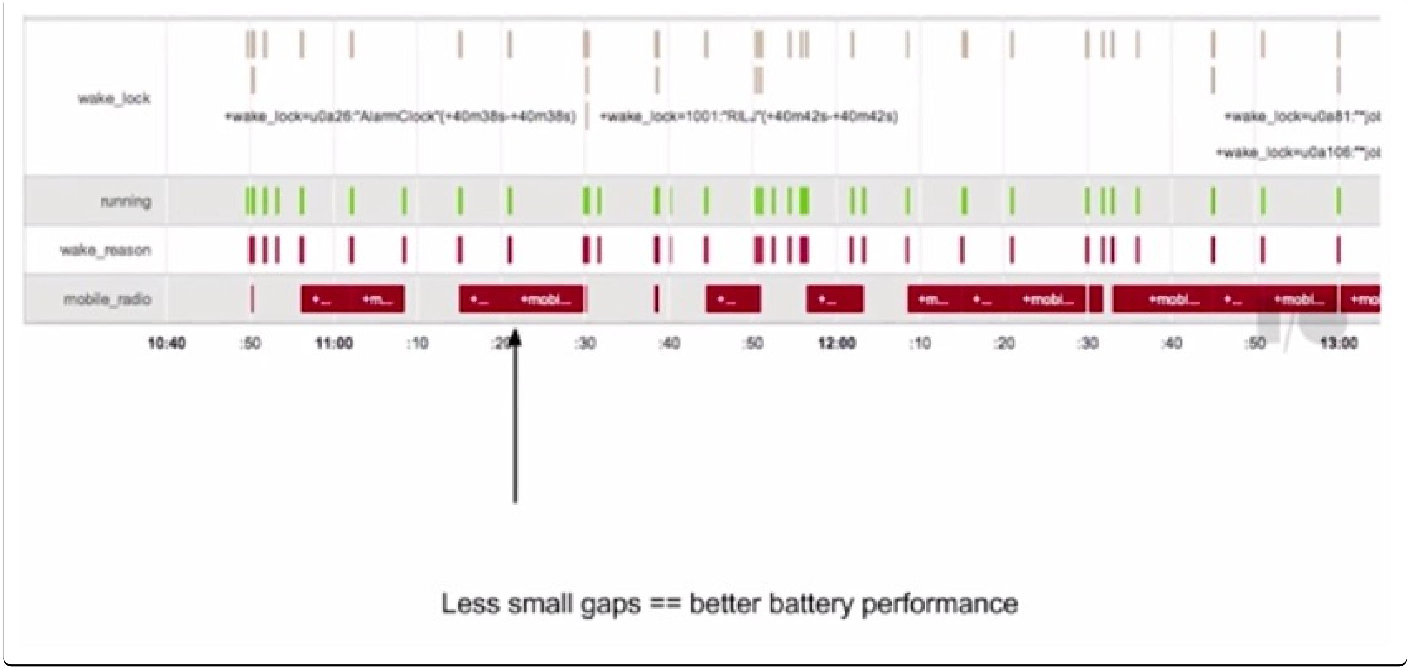


总之，为了减少电量的消耗，在蜂窝移动网络下，最好做到批量执行网络请求，尽量避免频繁的间隔网络请求。

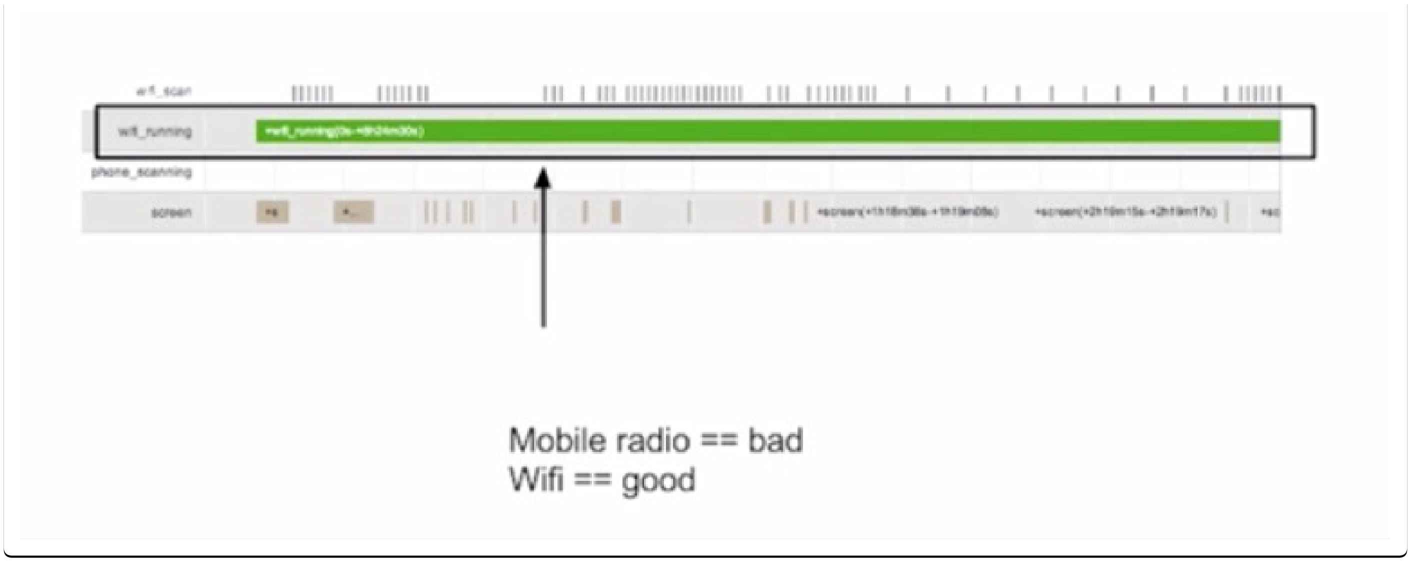
通过前面学习到的Battery Historian我们可以得到设备的电量消耗数据，如果数据中的移动蜂窝网络(Mobile Radio)电量消耗呈现下面的情况，间隔很小，又频繁断断续续的出现，说明电量消耗性能很不好：


wake_lock
running
wake_reason
wake_reason=0:"200:qcom,smd-rpm:203:fc4281d0.qcom,mpm:222:fc4cf000.qcom,spmi"(+13m53s-+13m53s)
wake_reason=0:"unknown"
wake_reason=0:"200:qcom,smd-rpm"
mobile_radio
+mobile_radio(+1h56m39s-+1h57m39s)
11:40
:50
12:00
:10
:20
:30
:40
:50
13:00
:10
:20
:30
:40
:50
14:00
Gap == chip asleep
Lots of gaps == wakeup/sleep/wakeup/sleep

经过优化之后，如果呈现下面的图示，说明电量消耗的性能是良好的：



另外WiFi连接下，网络传输的电量消耗要比移动网络少很多，应该尽量减少移动网络下的数据传输，多在WiFi环境下传输数据。



那么如何才能够把任务缓存起来，做到批量化执行呢？下面就轮到Job Scheduler出场了。

6)Using Job Scheduler

使用Job Scheduler，应用需要做的事情就是判断哪些任务是不紧急的，可以交给Job Scheduler来处理，Job Scheduler集中处理收到的任务，选择合适的时间，合适的网络，再一起进行执行。

下面是使用Job Scheduler的一段简要示例，需要先有一个JobService：

```java
public class MyJobService extends JobService {
    private static final String LOG_TAG = "MyJobService";

    @Override
    public void onCreate() {
        super.onCreate();
        Log.i(LOG_TAG, "MyJobService created");
    }

    @Override
    public void onDestroy() {
        super.onDestroy();
        Log.i(LOG_TAG, "MyJobService destroyed");
    }

    @Override
    public boolean onStartJob(JobParameters params) {
        // This is where you would implement all of the logic for your job. N
        // on the main thread, so you will want to use a separate thread for
        // (as we demonstrate below to establish a network connection).
        // If you use a separate thread, return true to indicate that you nee
        // return to the job at some point in the future to finish processing
        // return false when finished.
        Log.i(LOG_TAG, "Totally and completely working on job " + params.getJ
        // First, check the network, and then attempt to connect.
        if (isNetworkConnected()) {
            new SimpleDownloadTask() .execute(params);
            return true;
        } else {
            Log.i(LOG_TAG, "No connection on job " + params.getJobId() + "; s
        }
        return false;
    }

    @Override
    public boolean onStopJob(JobParameters params) {
        // Called if the job must be stopped before jobFinished() has been ca
        // happen if the requirements are no longer being met, such as the us
        // connecting to WiFi, or the device no longer being idle. Use this c
        // anything that may cause your application to misbehave from the job
        // Return true if the job should be rescheduled based on the retry cr
        // when the job was created or return false to drop the job. Regardle
        // returned, your job must stop executing.
        Log.i(LOG_TAG, "Whelp, something changed, so I'm calling it on job " 
        return false;
    }

    /**
     * Determines if the device is currently online.
     */
    private boolean isNetworkConnected() {
        ConnectivityManager connectivityManager =
                (ConnectivityManager) getSystemService(Context.CONNECTIVITY_S
        NetworkInfo networkInfo = connectivityManager.getActiveNetworkInfo();
        return (networkInfo != null && networkInfo.isConnected());
    }

    /**
     * Uses AsyncTask to create a task away from the main UI thread. This ta
     * HTTPUrlConnection, and then downloads the contents of the webpage as
     * The InputStream is then converted to a String, which is logged by the
     * onPostExecute() method.
     */
    private class SimpleDownloadTask extends AsyncTask<JobParameters, Void, S

        protected JobParameters mJobParam;

        @Override
        protected String doInBackground(JobParameters... params) {
            // cache system provided job requirements
            mJobParam = params[0];
            try {
                InputStream is = null;
                // Only display the first 50 characters of the retrieved web
                int len = 50;

                URL url = new URL("https://www.google.com");
                HttpURLConnection conn = (HttpURLConnection) url.openConnecti
                conn.setReadTimeout(10000); //10sec
                conn.setConnectTimeout(15000); //15sec
                conn.setRequestMethod("GET");
                //Starts the query
                conn.connect();
                int response = conn.getResponseCode();
                Log.d(LOG_TAG, "The response is: " + response);
                is = conn.getInputStream();

                // Convert the input stream to a string
                Reader reader = null;
                reader = new InputStreamReader(is, "UTF-8");
                char[] buffer = new char[len];
                reader.read(buffer);
                return new String(buffer);

            } catch (IOException e) {
                return "Unable to retrieve web page.";
            }
        }

        @Override
        protected void onPostExecute(String result) {
            jobFinished(mJobParam, false);
            Log.i(LOG_TAG, result);
        }
    }
}
```

然后模拟通过点击Button触发N个任务，交给JobService来处理

```java
public class FreeTheWakelockActivity extends ActionBarActivity {
    public static final String LOG_TAG = "FreeTheWakelockActivity";

    TextView mWakeLockMsg;
    ComponentName mServiceComponent;

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_wakelock);

        mWakeLockMsg = (TextView) findViewById(R.id.wakelock_txt);
        mServiceComponent = new ComponentName(this, MyJobService.class);
        Intent startServiceIntent = new Intent(this, MyJobService.class);
        startService(startServiceIntent);

        Button theButtonThatWakelocks = (Button) findViewById(R.id.wakelock_po
        theButtonThatWakelocks.setText(R.string.poll_server_button);

        theButtonThatWakelocks.setOnClickListener(new View.OnClickListener() {
            @Override
            public void onClick(View v) {
                    pollServer();
            }
        });
    }

    /**
     * This method polls the server via the JobScheduler API. By scheduling th
     * your app can be confident it will execute, but without the need for a w
     * API will take your network jobs and execute them in batch to best take
     * initial network connection cost.
     *
     * The JobScheduler API works through a background service. In this sample
     * a simple service in MyJobService to get you started. The job is schedul
     * the activity, but the job itself is executed in MyJobService in the sta
     * example, to poll your server, you would create the network connection,
     * request, and then process the response all in MyJobService. This allows
     * to invoke your logic without needed to restart your activity.
     *
     * For brevity in the sample, we are scheduling the same job several times
     * but again, try to consider similar tasks occurring over time in your ap
     * afford to wait and may benefit from batching.
     */
    public void pollServer() {
        JobScheduler scheduler = (JobScheduler) getSystemService(Context.JOB_S
        for (int i=0; i<10; i++) {
            JobInfo jobInfo = new JobInfo.Builder(i, mServiceComponent)
                    .setMinimumLatency(5000) // 5 seconds
                    .setOverrideDeadline(60000) // 60 seconds (for brevity in
                    .setRequiredNetworkType(JobInfo.NETWORK_TYPE_ANY) // WiFi
                    .build();

            mWakeLockMsg.append("Scheduling job " + i + "!\n");
            scheduler.schedule(jobInfo);
        }
    }
}
```

Notes:关于更多电量优化，还有一篇文章，请点击这里