Android程序设计

服务和广播

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内容

- Service
- 消息传递
- BroadcastReceiver

服务(Service)

- **概述**

  - Service与Activity类似，只是没有界面。使用Servcie要先定义一个Service子类，并在AndroidManifest.xml中配置它。
  - Service和Activity一样，都是从Context派生出来的，因此，都可以使用getResources()和getContentResolver()。
  - 有两种服务启动的方法：

    (1) 直接启动Service：通过Context的startService()方法启动Service，访问者与Service之间没有关联，即使访问者退出了，Service也依然运行。

    (2) 用绑定启动Service：通过Context的bindService()方法启动Service，访问者与Service绑定在一起，访问者退出了，Service也就终止了。
  - 在绑定启动服务的方法中，有单线程和多线程两种启动方法:
    在主线程中直接启动服务，如果服务时间过长会出现跳帧现象，系统会发出ANR（Application Not Responding）异常警告；用IntentService启动会把Service放在子线程中执行，可以克服了跳帧现象。

参考

- 直接启动Service

项目名：NewFirstService

MainActivity.java

```
import android.support.v7.app.AppCompatActivity; import android.widget.Button;
import android.os.Bundle; import android.content.Intent;
import android.view.View; import android.view.View.OnClickListener;
public class MainActivity extends AppCompatActivity {
    Button start, stop;
    @Override
    public void onCreate(Bundle savedInstanceState){
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);
        start = (Button) findViewById(R.id.start);
        stop = (Button) findViewById(R.id.stop);
        start.setOnClickListener(new OnClickListener(){
            @Override
            public void onClick(View arg0){
                Intent intent = new Intent(this,FirstService.class);
                startService(intent);
            }
        });
        stop.setOnClickListener(new OnClickListener(){
            @Override
            public void onClick(View arg0){
                Intent intent = new Intent(this,FirstService.class);
                stopService(intent);
            }
        });
    }
}
```

FirstService.java

```
import android.app.Service;
import android.content.Intent;
import android.os.IBinder;

public class FirstService extends Service{
   @Override
   public IBinder onBind(Intent arg0){          // 必须实现的方法
      return null;
   }
   @Override
   public void onCreate() {                     // Service被创建时回调该方法。
      super.onCreate();
      System.out.println("Service is Created");
   }
   // Service被启动时回调该方法
   @Override
   public int onStartCommand(Intent intent, int flags, int startId){
      System.out.println("Service is Started");
      return START_STICKY;
   }
   @Override
   public void onDestroy(){                     // Service被关闭之前回调。
      super.onDestroy();
      System.out.println("Service is Destroyed");
   }
}
```

activity_main.xml

```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
    android:orientation="horizontal"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    android:gravity="center_horizontal"
    >
    <Button
        android:id="@+id/start"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="start"
        />
    <Button
        android:id="@+id/stop"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="stop"
        />
</LinearLayout>
```

AndroidManifest.xml

```
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="com.example.isszym.myapplication">

    <application
        android:allowBackup="true"
        android:icon="@mipmap/ic_launcher"
        android:label="@string/app_name"
        android:supportsRtl="true"
        android:theme="@style/AppTheme">
        <activity android:name=".MainActivity">
            <intent-filter>
                <action android:name="android.intent.action.MAIN" />
                <category android:name="android.intent.category.LAUNCHER" />
            </intent-filter>
        </activity>

        <service
            android:name=".FirstService"
            android:enabled="true"
            android:exported="true">
        </service>
    </application>

</manifest>
```

点击了两次START，一次STOP，run的信息：

I/System.out: Service is Created
I/System.out: Service is Started
I/System.out: Service is Started
I/System.out: Service is Destroyed

● 用绑定方式启动服务(BindService)----单线程

项目名：NewBindService

MainActivity.java

```
import android.support.v7.app.AppCompatActivity;
import android.os.Bundle;import android.app.Service;
import android.content.ComponentName;import android.content.Intent;
import android.content.ServiceConnection;
import android.os.Ibinder;import android.view.View;
import android.view.View.OnClickListener;
import android.widget.Button;import android.widget.Toast;

public class MainActivity extends AppCompatActivity {
    Button bind, unbind, getServiceStatus;
    BindService.MyBinder binder;              // 保持所启动的Service的IBinder对象

    private ServiceConnection conn = new ServiceConnection(){
        //与Service连接成功时回调
        @Override
        public void onServiceConnected(ComponentName name, IBinder service){
            System.out.println("--Service Connected--");
            // 获取Service的onBind方法所返回的MyBinder对象
            binder = (BindService.MyBinder) service;
        }
        // 与Service断开连接时回调该方法
        @Override
        public void onServiceDisconnected(ComponentName name) {
            System.out.println("--Service Disconnected--");
        }
    };
```

```
    @Override
    public void onCreate(Bundle savedInstanceState)  {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);
        bind = (Button) findViewById(R.id.bind);
        unbind = (Button) findViewById(R.id.unbind);
        getServiceStatus = (Button) findViewById(R.id.getServiceStatus);
        final Intent intent = new Intent(this,BindService.class);
        bind.setOnClickListener(new OnClickListener() {
            @Override
            public void onClick(View source) {
                bindService(intent, conn, Service.BIND_AUTO_CREATE);
            }
        });
        unbind.setOnClickListener(new OnClickListener() {
            @Override
            public void onClick(View source) {
                unbindService(conn);
            }
        });
        getServiceStatus.setOnClickListener(new OnClickListener() {
            @Override
            public void onClick(View source) {
                Toast.makeText(MainActivity.this,
                        "Serivce的count值为: " + binder.getCount(),
                        Toast.LENGTH_SHORT).show(); //②
            }
        });
    }
}
```

BindService.java

```
import android.app.Service;
import android.content.Intent;
import android.os.IBinder;
import android.os.Binder;

public class BindService extends Service {
    private int count;
    private boolean quit;
    private MyBinder binder = new MyBinder();   // 定义onBinder方法所返回的对象
    public BindService() { }
    @Override
    public IBinder onBind(Intent intent) {       // 绑定该Service时回调该方法
        System.out.println("Service is Binded");
        return binder;
        // TODO: Return the communication channel to the service.
        //throw new UnsupportedOperationException("Not yet implemented");
    }
    public class MyBinder extends Binder {  // 通过继承Binder来实现IBinder类
        public int getCount() {              // 获取Service的运行状态：count
            return count;
        }
    }
```

```
    @Override
    public void onCreate(){
        super.onCreate();
        System.out.println("Service is Created");
        // 启动一条线程、动态地修改count状态值
        new Thread() {
            @Override
            public void run() {
                while (!quit) {
                    try  {Thread.sleep(1000); }
                    catch (InterruptedException e) { }
                    count++;
                }
            }
        }.start();
    }
    @Override
    public boolean onUnbind(Intent intent){   // Service被断开连接时回调该方法
        System.out.println("Service is Unbinded");
        return true;
    }
    @Override
    public void onDestroy(){          // Service被关闭之前回调该方法。
        super.onDestroy();
        this.quit = true;
        System.out.println("Service is Destroyed");
    }
}
```

activity_main.xml

```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
    android:orientation="horizontal"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    android:gravity="center_horizontal"
    >
    <Button
        android:id="@+id/bind"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="bind"
        android:textSize="14dp" />
    <Button
        android:id="@+id/unbind"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="unbind"
        android:textSize="14dp" />
    <Button
        android:id="@+id/getServiceStatus"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="getServiceStatus"
        android:textSize="14dp" />
</LinearLayout>
```

AndroidManifest.xml

```
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="com.example.isszym.newbindservice">

    <application
        android:allowBackup="true"
        android:icon="@mipmap/ic_launcher"
        android:label="@string/app_name"
        android:supportsRtl="true"
        android:theme="@style/AppTheme">
        <activity android:name=".MainActivity">
            <intent-filter>
                <action android:name="android.intent.action.MAIN" />
                <category android:name="android.intent.category.LAUNCHER" />
            </intent-filter>
        </activity>

        <service
            android:name=".BindService"
            android:enabled="true"
            android:exported="true"></service>
    </application>

</manifest>
```

多次点击BIND，只有第一次有输出，然后点击GETSERVICESTATUS，得到左图，最后点击一次UNBIND，run的信息：

03/20 21:52:11: Launching app
I/System.out: Service is Created
I/System.out: Service is Binded
I/System.out: --Service Connected--

点击BIND

I/System.out: Service is Unbinded
I/System.out: Service is Destroyed

点击UNBIND

- 启动意图服务(IntentService)---多线程

一般的服务是在主线程里启动，如果服务执行时间太长，系统会发出跳帧警告，采用IntentService可以把服务在子线程中启动。

项目：NewIntentService

MainActivity.java

```
import android.support.v7.app.AppCompatActivity;
import android.os.Bundle;import android.os.Bundle;
import android.view.View;import android.app.Activity;
import android.content.Intent;
public class MainActivity extends AppCompatActivity {
    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);
    }

    public void startService(View source) {
        Intent intent = new Intent(this, MyService.class);
        startService(intent); // 启动Service
    }

    public void startIntentService(View source){
        Intent intent = new Intent(this, MyIntentService.class);
        startService(intent); // 启动IntentService
    }
}
```

MyIntentService.java

```java
import android.app.IntentService;
import android.content.Intent;
import android.content.Context;

public class MyIntentService extends IntentService {
     public MyIntentService() {
         super("MyIntentService");
    }

    // IntentService会使用单独的线程来执行该方法的代码
    @Override
    protected void onHandleIntent(Intent intent) {
        // 该方法内可以执行任何耗时任务，比如下载文件等，此处只是让线程暂停20秒
        long endTime = System.currentTimeMillis() + 20 * 1000;
        System.out.println("---IntentService onStart---");
        while (System.currentTimeMillis() < endTime) {
            synchronized (this) {
                try  {
                    wait(endTime - System.currentTimeMillis());
                }
                catch (Exception e) {
                }
            }
        }
        System.out.println("---IntentService完成任务---");
    }
}
```

MyService.java

```
import android.app.Service;
import android.content.Intent;
import android.os.IBinder;

public class MyService extends Service {
    public MyService() {
    }
    @Override
    public IBinder onBind(Intent intent) {
        return null;
    }
    @Override
    public int onStartCommand(Intent intent, int flags, int startId)  {
        long endTime = System.currentTimeMillis() + 20 * 1000;
        System.out.println("---Service onStart---");
        while (System.currentTimeMillis() < endTime) {
            synchronized (this) {
                try {
                    wait(endTime - System.currentTimeMillis());
                }
                catch (Exception e) {
                }
            }
        }
        System.out.println("---Service完成任务---");
        return START_STICKY; //被系统终止后自动重启服务
    }
}
```

activity_main.xml

```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    android:padding="20dp"
    android:orientation="vertical">
    <Button
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:onClick="startService"
        android:textSize="20sp"
        android:text="start_service"/>

    <Button
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:onClick="startIntentService"
        android:text="start_intent_service"
        android:textSize="20sp" />
</LinearLayout>
```

AndroidManifest.xml

```
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="com.example.isszym.newintentservice">

    <application
        android:allowBackup="true"
        android:icon="@mipmap/ic_launcher"
        android:label="@string/app_name"
        android:supportsRtl="true"
        android:theme="@style/AppTheme">
        <activity android:name=".MainActivity">
            <intent-filter>
                <action android:name="android.intent.action.MAIN" />
                <category android:name="android.intent.category.LAUNCHER" />
            </intent-filter>
            <service android:name=".MyIntentService" />
            <service android:name=".MyService" />
        </activity>
        <service
            android:name=".MyIntentService"
            android:exported="false" />
        <service
            android:name=".MyService"
            android:enabled="true"
            android:exported="true"></service>
    </application>
</manifest>
```


2:33
NewIntentService
START_SERVICE
START_INTENT_SERVICE

每次从*onStart*到*任务完成*都是20秒，run的信息：

- I/System.out: ---IntentService onStart---
- I/System.out: ---IntentService完成任务---
- I/System.out: ---IntentService onStart---
- I/System.out: ---IntentService完成任务---
- I/System.out: ---IntentService onStart---
- I/System.out: ---IntentService完成任务---
- I/System.out: ---Service onStart---
- I/System.out: ---Service完成任务---
- I/Choreographer**: Skipped 1200 frames! The application may be doing too much work on its main thread.**
- I/System.out: ---Service onStart---
- I/System.out: ---Service完成任务---
- I/Choreographer: **Skipped 1199 frames! The application may be doing too much work on its main thread.**
- I/System.out: ---IntentService onStart---
- I/System.out: ---IntentService完成任务---

连续点击了三次Start_Intent_Service

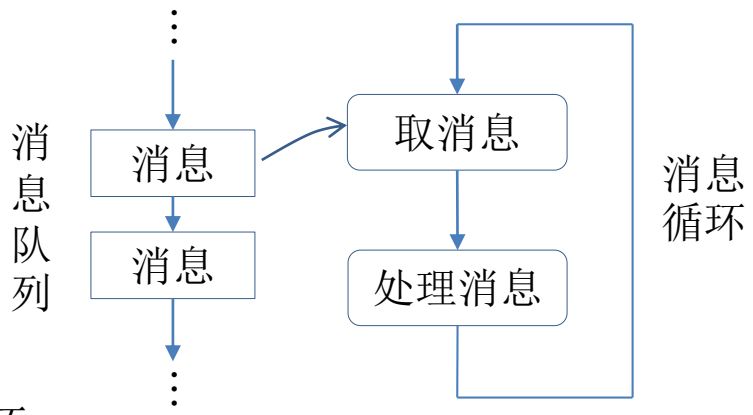
点击了一次Start_Service

点击了一次Start_Service，马上又点击了Start_Intent_Service

消息传递

浅析Android中的消息机制
android handler线程原理详详解
Android的消息机制

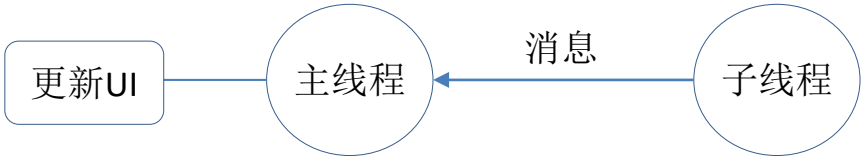
- 安卓系统只能在主线程（UI线程）更新视图（View），而不能在子线程中直接更新视图。子线程要通过发送消息（Message）给主线程，让主线程更新视图。
- 消息传递是线程通信的一种方法。进程通信不能使用这种方法。
- 安卓系统采用消息队列（Message Queue）和消息循环（Message Loop）实现的消息处理机制。
- 主线程启动时系统会自动为其创建一个消息队列和消息循环，而子线程默认是没有的消息队列和消息循环。



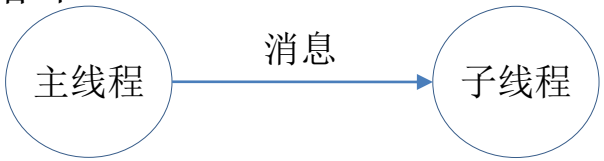
- Looper对象负责管理线程的消息队列和消息循环。子线程通过Looper.myLooper()得到Looper对象，而主线程要通过Looper.getMainLooper()得到。子线程要执行Looper.prepare()创建消息队列，然后调用Looper.loop()来启动消息循环。
- 线程要通过Handler对象来访问Looper对象并发送和接收消息。
- Looper对象对队列的操作是受同步保护的。只有在有消息循环的线程中才可以创建Handler对象。

- 主线程与子线程有多种消息传递方式：

（1）主线程创建Handler对象来处理消息，子线程通过Handler对象向主线程发送消息，让主线程更新UI。用这种方式可以把繁重的计算任务交给子线程去完成。



（2）主线程向子线程传递消息。由于子线程默认没有消息循环，子线程需要创建和执行消息循环。



（3） 创建Handler对象时可以指定Looper对象， Handler对象通过该Looper对象传递消息。

（4）可以在主线程的各个组件之间传递消息。

（5）把Runnable对象加入消息循环，由该消息循环启动该线程。

- 消息格式

```
public final class Message implements Parcelable {
    public int what;        // 用户自定义消息编码
    public int arg1;        // 参数1--data的补充(开销低)
    public int arg2;        // 参数2--data的补充(开销低)
    public Object obj;      // 对象---data的补充(开销低)
    Bundle data;
    int flags;
    long when;              // 延迟时间
    Handler target;
    Message next;
    public void sendToTarget() {
        target.sendMessage(this);
    }
}
```

- 创建Handler实例的时候会取到Looper类的消息循环和消息队列

```
public Handler(Callback callback, boolean async) {
    ...
    mLooper = Looper.myLooper();
    mQueue = mLooper.mQueue;
    ...
}
```

- Handler类的把消息加入消息队列

```
boolean enqueueMessage(MessageQueue queue, Message msg, long uptimeMillis)
```

- Handler类的发送消息时用enqueueMessage加入消息：

```
boolean sendEmptyMessage(int what)
boolean sendMessage(Message msg)
boolean sendMessageDelayed(Message msg, long delayMillis)
boolean sendEmptyMessageDelayed(int what, long delayMillis)
boolean sendMessageAtTime(Message msg, long uptimeMillis)
```

- Handler类的生成消息的方法：

```
Message obtainMessage(int what, int arg1, int arg2, Object obj)
Message obtainMessage(int what, Object obj)
```

- 项目**NewSendMsgToMainThrd**

子线程通过消息数据或共享变量向主线程发送消息。

```
public class MainActivity extends AppCompatActivity {
    private static final int COMPLETED = 0x123;
    private static final int DONE = 0x124;
    private int cnt = 0;
    private TextView stateText;
    private Handler handler = new Handler() {
        @Override
        public void handleMessage(Message msg) {
            switch(msg.what) {
                case COMPLETED:
                    stateText.setText("Finished! " + cnt);
                    break;
                case DONE:
                    String body = (String) msg.obj;
                    stateText.setText(body);
                    break;
            }
        }
    };
    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);
        stateText = (TextView) findViewById(R.id.tv);
    }
```

(1) 消息循环会从消息队列中取出消息msg。
(2) 调用该消息的handler（msg.target）的dispatchMessage进行处理。
(3) dispatchMessage会调用handleMessage进行处理。

```
    public void onClick1(View v) {
        new Thread(){
            @Override
            public void run() {
                try {  Thread.sleep(2000);  }catch(Exception e) {
                };//耗时的操作
                synchronized(this) {
                    cnt++;  //利用共享变量在主线程和子线程之间传递数据
                }
                handler.sendEmptyMessage(COMPLETED);
            }
        }.start();
    }
    public void onClick2(View v) {
        new Thread(){
            @Override
            public void run() {
                try {Thread.sleep(2000);}catch(Exception e){};//耗时的操作
                synchronized(this) {
                    cnt++;  //利用共享变量在主线程和子线程之间传递数据
                }
                handler.obtainMessage(DONE, "Hello! " + cnt).sendToTarget();
            }
        }.start();
    }
}
```

用bundle传数据见下一个例子

activity_main.xml

```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
    android:orientation ="vertical"
    android:layout_width="match_parent"
    android:layout_height="match_parent">
    <TextView
        android:id ="@+id/tv"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="Hello World!" />
    <Button
        android:id ="@+id/btn"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="Click me!"
        android:onClick="onClick1"/>
    <Button
        android:id ="@+id/btn2"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="Click here!"
        android:onClick="onClick2"/>
</LinearLayout>
```

连续点击两次CLICK ME之后（要等4秒）

点击两次CLICK HERE之后（要等4秒）

- 工程名 **NewSendMsgToSubthrd** 主线程通过子线程的Handler发送消息给子线程。

主线程通过消息的Data属性(Bundle)向子线程传递数据

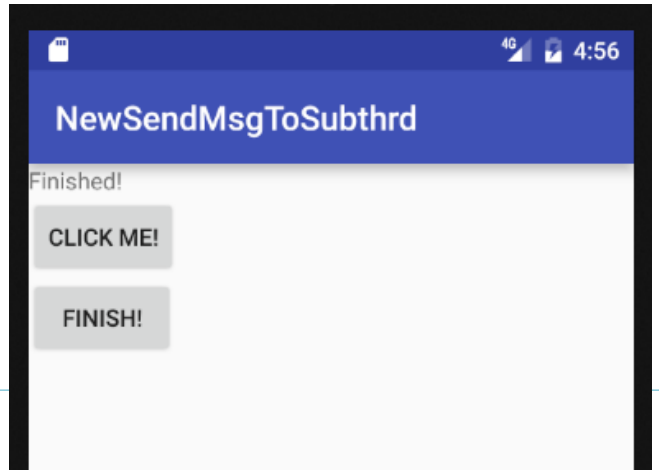
```
public class MainActivity extends AppCompatActivity {
    private static final int SEND = 0x100;
    private static final int COMPLETED = 0x123;
    private TextView stateText;
    private Button btn;
    int count = 0;
    WorkThread thr = new WorkThread();  //建立新线程

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);
        stateText = (TextView) findViewById(R.id.tv);
        thr.start();   //启动线程
    }

    public void click1(View v) {
        if (thr == null) return;
        count++;
        stateText.setText("count: " + count);
        Message msg = new Message();
        Bundle bundle = new Bundle();
        bundle.putString("status", "Send " + count + "!");
        msg.setData(bundle); // 消息可以带数据
        msg.what = SEND;    // 消息自定义类型. 用arg1,arg2可以定义子类型
        thr.mHandler.sendMessage(msg); //使用子线程Handler发送消息
    }
```

```
    public void click2(View v) {
        if (thr == null) return;
        stateText.setText("Finished!");
        Message msg = new Message();
        msg.what = COMPLETED;
        thr.mHandler.sendMessage(msg);
        thr = null;
    }
    class WorkThread extends Thread {
        public Handler mHandler;
        public void run() {
            Looper.prepare(); //创建消息队列
            mHandler = new Handler() {
                public void handleMessage(Message msg) {//处理消息队列中收到的消息
                    if (msg.what == SEND) {
                        Log.i("test", msg.getData().getString("status"));
                    } else {
                        if (msg.what == COMPLETED) {
                            Looper.myLooper().quit();  // 结束消息循环。
                        }                                    //版本大于18时可以用safetyQuit()
                    }
                }
            };
            Looper.loop();  //启动消息循环
        }
    }
}
```

activity_main.xml

```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
    android:orientation ="vertical"
    android:layout_width="match_parent"
    android:layout_height="match_parent">
    <TextView
        android:id ="@+id/tv"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="init!" />
    <Button
        android:id ="@+id/btn1"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="Click Me!"
        android:onClick="click1"/>
    <Button
        android:id ="@+id/btn2"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="Finish!"
        android:onClick="click2"/>
</LinearLayout>
```


```
I/test: Send 1!
I/test: Send 2!
I/test: Send 3!
I/test: Send 4!
I/test: Send 5!
I/test: Send 6!
I/test: Send 7!
I/test: Send 8!
```



- 工程名 **NewHandlerMainLooper**：选择子线程或主线程Looper创建Handler。

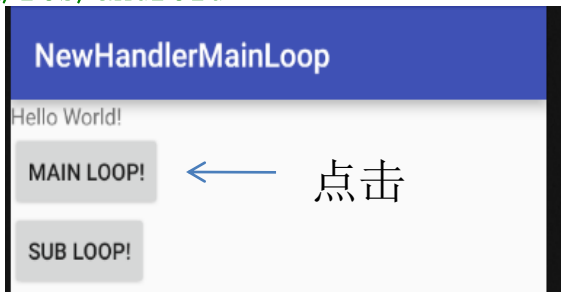
MainActivity.java

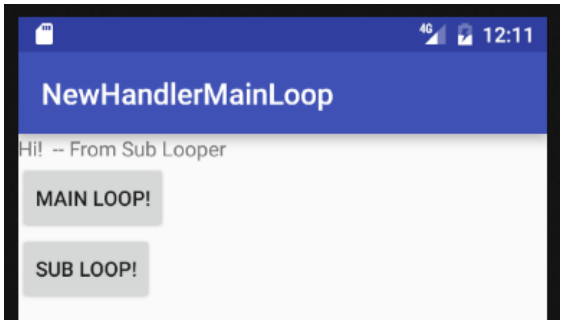
```
public class MainActivity extends AppCompatActivity {
    TextView tv1 = null;
    MyThread thrd;
    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);
        tv1 = (TextView) findViewById(R.id.tv1);
        thrd = new MyThread();
        thrd.start();
    }
    private class MyHandler extends Handler {
        public MyHandler(Looper looper) {
            super(looper);
        }
        @Override
        public void handleMessage(Message msg) { // 处理消息
            if (msg.what == 0x100)
                tv1.setText("Hi!  -- From Main Looper");
            else if (msg.what == 0x123)
                tv1.setText("Hi!  -- From Sub Looper");
        }
    }
```

```
    public void click(View v) {
        switch (v.getId()) {
            case R.id.btn1:
                new MyHandler(Looper.getMainLooper()).sendEmptyMessage(0x100);
                break;
            case R.id.btn2:
                new MyHandler(thrd.getLooper()).sendEmptyMessage(0x123);
        }
    }
    private class MyThread extends Thread {
        public Looper getLooper() {
            return Looper.myLooper();
        }
        @Override
        public void run() {
            Looper.prepare();
            Looper.loop();
        }
    }
}
```

activity_main.xml

```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
    android:orientation = "vertical"
    android:layout_width="match_parent"
    android:layout_height="match_parent">
    <TextView
        android:id="@+id/tv1"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="Hello World!" />
    <Button
        android:id="@+id/btn1"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="Main Loop!"
        android:onClick="click"/>
    <Button
        android:id="@+id/btn2"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="Sub Loop!"
        android:onClick="click"/>
</LinearLayout>
```





- 工程名 **NewHandlerAllInMain**：发送消息和处理消息都在主线程进行

MainActivity.java

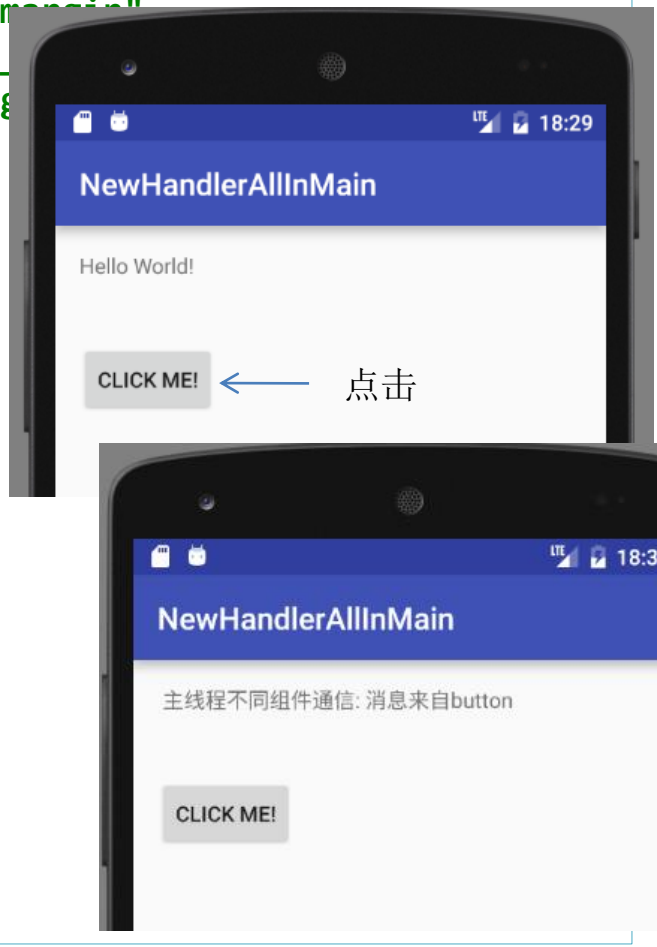
```
public class MainActivity extends AppCompatActivity implements View.OnClickListener {
    Button button;
    TextView text;
    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);
        button = (Button) findViewById(R.id.btn1);
        button.setOnClickListener(MainActivity.this);
        text = (TextView) findViewById(R.id.tv1);
    }
    public void onClick(View v) {
        switch (v.getId()) {
            case R.id.btn1:
                Looper looper = Looper.myLooper(); // 取得当前线程里的Looper
                MyHandler mHandler = new MyHandler(looper);
                // 构造一个handler 使之可与Looper 通信
                //buton 等组件可以由mHandler 将消息传给Looper 后,
                // 再放入messageQueue 中, 同时mHandler 也可以接受来自Looper 消息
                mHandler.removeMessages(0);   //清除what=0的消息
                String msgStr = " 主线程不同组件通信：消息来自button";
                Message m = mHandler.obtainMessage(1, 1, 1, msgStr); // 构造消息
                mHandler.sendMessage(m); // 发送消息
                break;
        }
    }
```

Message obtainMessage(int what, int arg1, int arg2, Object obj)

```
    private class MyHandler extends Handler {
        public MyHandler(Looper looper) {
            super(looper);
        }

        @Override
        public void handleMessage(Message msg) { // 处理消息
            text.setText(msg.obj.toString());
        }
    }
}
```

activity_main.xml

```
<?xml version="1.0" encoding="utf-8"?>
<RelativeLayout xmlns:android="http://schemas.android.com/apk/res/android"
    xmlns:tools="http://schemas.android.com/tools"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    android:paddingBottom="@dimen/activity_vertical_margin"
    android:paddingLeft="@dimen/activity_horizontal_
    android:paddingRight="@dimen/activity_horizontal_
    android:paddingTop="@dimen/activity_vertical_marg

    <TextView
        android:id="@+id/tv1"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="Hello World!" />

    <Button
        android:id="@+id/btn1"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="Click Me!"
        android:layout_below="@+id/tv1"
        android:layout_alignParentLeft="true"
        android:layout_alignParentStart="true"
        android:layout_marginTop="41dp" />
</RelativeLayout>
```



- 工程名 **NewHandlerRunnable**：在主线程的消息队列中启动Runnable子类的实例。

MainActivity.java

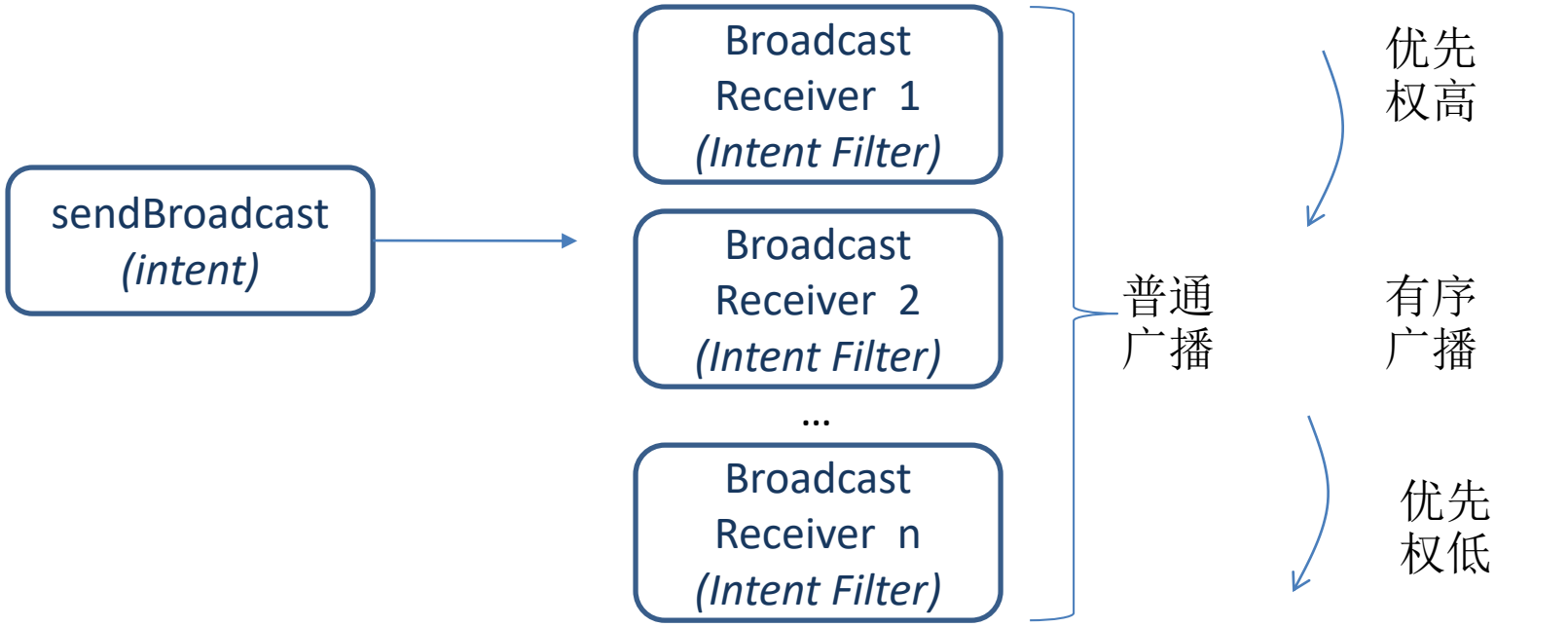
```
public class MainActivity extends AppCompatActivity {
    TextView mText;  int count= 0;
    Handler mHandler = new Handler(){
        @Override public void handleMessage(Message msg) { // 处理消息
            if (msg.what == 0x123)
                mText.setText("Hi!  -- From Sub Looper");
        }
    };
    @Override  protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);
        mText = (TextView) findViewById(R.id.text0);//一个TextView
    }
    public void click1(View vw) {
        mHandler.postDelayed(r,3000);  //3秒后把r加入循环队列
    };                                          延迟把新线程加入消息循环队列
    public void click2(View vw) {
        mHandler.removeCallbacks(r);  //停止线程
    }
    Runnable r = new Runnable() {
        @Override public void run() {
            Message msg = mHandler.obtainMessage();
            msg.what = 0x123;
            mHandler.sendMessage(msg);
        }
    };
}
```

activity_main.xml

```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    android:orientation="vertical">
    <TextView
        android:id="@+id/text0"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="Hello World!" />
    <Button
        android:id="@+id/btn1"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="add thread!"
        android:onClick="click1" />
    <Button
        android:id="@+id/btn2"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="stop thread!"
        android:onClick="click2" />
</LinearLayout>
```

BroadcastReceiver

用带有Intent匹配条件的组件用sendBroadcast发出广播消息，所有匹配了Intent条件的接收者都可以收到广播消息。

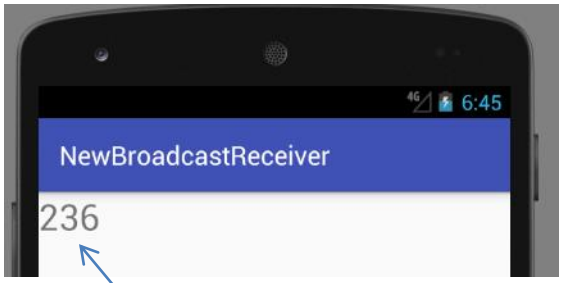


普通广播是所有匹配的接收者均可同时收到广播消息，而有序广播让广播消息根据接收者的优先权依次经过每个接收者，每个接收者都可以停止继续传播消息，高优先级的Receiver通过setResultExtras方法来发送数据，低优先级的接受者通过getResultExtras来获取Bundle数据包，进而获取数据，他们都可以用intent的Bundle来获取最初的广播发送者发出的消息。 参考 参考

项目名：NewBroadcastReceiver

MainActivity.java

```
public class MainActivity extends AppCompatActivity {
    private TextView tv1 = null;
    private MyReceiver receiver = null;
    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);
        tv1 = (TextView) findViewById(R.id.tv1);
        receiver = new MyReceiver();
        IntentFilter filter = new IntentFilter();
        filter.addAction("com.example.activity.CountService");
        MainActivity.this.registerReceiver(receiver, filter);
    }
    @Override
    protected void onDestroy() {
        super.onDestroy();
        unregisterReceiver(receiver);
    }
    public class MyReceiver extends BroadcastReceiver {
        @Override
        public void onReceive(Context context, Intent intent) {
            Bundle bundle = intent.getExtras();
            int count = bundle.getInt("count");
            tv1.setText(""+count);
        }
    }
}
```



计数值

activity_main.xml

```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
    android:layout_width="match_parent"
    android:layout_height="match_parent">
    <TextView
        android:id="@+id/tv1"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="" />
</LinearLayout>
```

AndroidManifest.xml

```
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="com.example.isszym.newbroadcastreceiver">
    <application
        android:allowBackup="true"
        android:icon="@mipmap/ic_launcher"
        android:label="@string/app_name"
        android:theme="@style/AppTheme">
        <activity android:name=".MainActivity">
            <intent-filter>
                <action android:name="android.intent.action.MAIN" />
                <category android:name="android.intent.category.LAUNCHER" />
            </intent-filter>
        </activity>
    </application>
</manifest>
```

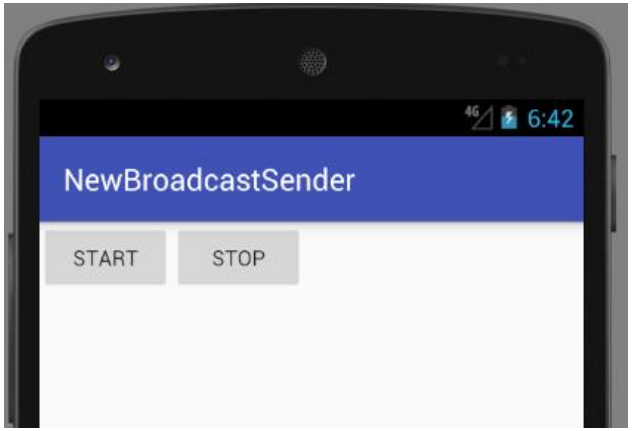
项目名：NewBroadcastSender

MainActivity.java

```
public class MainActivity extends AppCompatActivity {
    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);  setContentView(R.layout.activity_main);
    }
    protected void startService(View v) {
        Intent intent = new Intent(this,CountService.class);  startService(intent);
    }
    protected void stopService(View v) {
        Intent intent = new Intent(this,CountService.class);  stopService(intent);
    }
}
```

activity_main.xml

```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    android:orientation="horizontal"  >
    <Button
        android:text="Start"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:onClick="startService" />
    <Button
        android:text="Stop"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:onClick="stopService" />
</LinearLayout>
```



CountService.java

```
public class CountService extends Service {
    private int count = 0;
    private boolean threadDisable=false;
    @Override
    public IBinder onBind(Intent intent) {
        throw new UnsupportedOperationException("Not yet implemented");
    }
    @Override
     public void onCreate() {
        super.onCreate();
        threadDisable=false;
        System.out.println("Service is Created");
        new Thread(new Runnable() {
            @Override
            public void run() {
                while (!threadDisable) {
                    try {
                        Thread.sleep(1000);
                    } catch (InterruptedException e) {
                        e.printStackTrace();
                    }
                    count++;
                    System.out.println(""+count);
                    Intent intent = new Intent();
                    intent.putExtra("count", count);
                    intent.setAction("com.example.activity.CountService");
                    sendBroadcast(intent);   //发送广播
                }
            }
        }).start();
    }
```

```
 @Override
    public int onStartCommand(Intent intent, int flags, int startId){
        System.out.println("Service is Started");
        return START_STICKY; //被系统终止后自动重启
    }
    @Override
    public void onDestroy(){       // Service被关闭之前回调。
        threadDisable=true;
        super.onDestroy();
    }
}
```

AndroidManifest.xml

```
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="com.example.isszym.newbroadcastsender">
    <application
        android:icon="@mipmap/ic_launcher"
        android:label="@string/app_name"
        android:theme="@style/AppTheme">
        <activity android:name=".MainActivity">
            <intent-filter>
                <action android:name="android.intent.action.MAIN" />
                <category android:name="android.intent.category.LAUNCHER" />
            </intent-filter>
        </activity>
        <service
            android:name=".CountService"
            android:enabled="true"
            android:exported="true"></service>
    </application>
</manifest>
```

项目名：NewSortedBroadcast

MainActivity.java

```
public class MainActivity extends AppCompatActivity {
    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);
    }
    public void onClick(View v) {
        Intent intent = new Intent();
        intent.setAction("com.example.action.SORTED_BROADCAST");
        intent.putExtra("main", "呵呵，all Receivers，你们好！");
        sendOrderedBroadcast(intent, null); //第二个参数为String receiverPermission，
            //    要求接收器必须具有相应权限才能正常接收到广播，取值null时没有权限。
    }
}
```

MyReceiver.java

```
public class MyReceiver extends BroadcastReceiver{
   @Override
   public void onReceive(Context context, Intent intent){
      Toast.makeText(context, intent.getStringExtra("main"), Toast.LENGTH_LONG).show();
      Bundle bundle = new Bundle();
      bundle.putString("first", "哈哈，Receiver 2，你好！");
      setResultExtras(bundle);
      // abortBroadcast(); /* 取消Broadcast的继续传播 */
   }
}
```

MyReceiver2.java

```
public class MyReceiver2 extends BroadcastReceiver{
    @Override
    public void onReceive(Context context, Intent intent)  {    // intent为最初的intent
        // getResultExtras的参数：为true，没数据则创建空Bundle，为false，没数据则返回null
        Bundle bundle = getResultExtras(true);
        String first = bundle.getString("first"); // 解析前一个BroadcastReceiver所存入的消息
        Toast.makeText(context, first, Toast.LENGTH_LONG).show();
        Toast.makeText(context, intent.getStringExtra("main"), Toast.LENGTH_LONG).show();
    }
}
```

activity_main.xml

```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
    android:orientation="vertical"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    >
    <Button
        android:layout_width="match_parent"
        android:layout_height="wrap_content"
        android:text="Send"
        android:onClick="onClick"
        />
</LinearLayout>
```

点击SEND后显示了三条信息

activity_main.xml

```
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="com.example.isszym.newsortedbroadcast">

    <application
        android:allowBackup="true"
        android:icon="@mipmap/ic_launcher"
        android:label="@string/app_name"
        android:supportsRtl="true"
        android:theme="@style/AppTheme">
        <activity android:name=".MainActivity">
            <intent-filter>
                <action android:name="android.intent.action.MAIN" />
                <category android:name="android.intent.category.LAUNCHER" />
            </intent-filter>
        </activity>

        <receiver android:name=".MyReceiver">
            <intent-filter android:priority="20">    <!-- -1000~1000  -->
                <action android:name="com.example.action.SORTED_BROADCAST" />
            </intent-filter>
        </receiver>
        <receiver android:name=".MyReceiver2">
            <intent-filter android:priority="0">
                <action android:name="com.example.action.SORTED_BROADCAST" />
            </intent-filter>
        </receiver>
    </application>

</manifest>
```

常见的系统广播

参考

- **系统启动完成**

如果需要在开机启动完成之后启动消息推送服务功能，就要订阅系统“启动完成”这条广播。

```
public class BootCompleteReceiver extends BroadcastReceiver {
    private static final String TAG = "BootCompleteReceiver";
    @Override
    public void onReceive(Context context, Intent intent) {
        Intent service = new Intent(context, MsgPushService.class);
        context.startService(service);
        Log.i(TAG, "Boot Complete. Starting MsgPushService...");
    }
}
```

```
<receiver android:name=".BootCompleteReceiver">
   <intent-filter>
      <!-- 注册开机广播地址-->
      <action android:name="android.intent.action.BOOT_COMPLETED"/>
      <category android:name="android.intent.category.DEFAULT" />
   </intent-filter>
</receiver>
```

- **网络状态变化**

当网络突然断开，通过接收系统广播消息对用户发出提醒并采取相应操作。

```
public class NetworkStateReceiver extends BroadcastReceiver {
    @Override
    public void onReceive(Context context, Intent intent) {   //network state changed
        if (!isNetworkAvailable(context))
            Toast.makeText(context, "network disconnected!", 0).show();
    }
    public static boolean isNetworkAvailable(Context context) {
        ConnectivityManager mgr = (ConnectivityManager)
               context.getSystemService(Context.CONNECTIVITY_SERVICE);
        NetworkInfo[] info = mgr.getAllNetworkInfo();
        if (info != null) {
            for (int i = 0; i < info.length; i++) {
                if (info[i].getState() == NetworkInfo.State.CONNECTED) return true;
            }
        }
        return false;
    }
}
```

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

- 电量变化

```
public class BatteryChangedReceiver extends BroadcastReceiver {
    private static final String TAG = "BatteryChangedReceiver";
    @Override
    public void onReceive(Context context, Intent intent) {
        // 当前电量
        int currLevel = intent.getIntExtra(BatteryManager.EXTRA_LEVEL, 0);
        // 总电量
        int total = intent.getIntExtra(BatteryManager.EXTRA_SCALE, 1);
        int percent = currLevel * 100 / total;
        Log.i(TAG, "battery: " + percent + "%");
    }
}
```

```
<receiver android:name=".BatteryChangedReceiver">
  <intent-filter>
     <action android:name="android.intent.action.BATTERY_CHANGED" />
     <category android:name="android.intent.category.DEFAULT" />
  </intent-filter>
</receiver>
```

- 监听SD卡状态

```
public class SDCardReceiver extends BroadcastReceiver {
    @Override
    public void onReceive(Context context, Intent intent) {
        String action = intent.getAction(); // 区分接收到的是哪个广播
        if(action.equals("android.intent.action.MEDIA_MOUNTED")){
            System.out.println("sd卡就绪");
        }
        else if(action.equals("android.intent.action.MEDIA_UNMOUNTED")){
            System.out.println("sd卡被移除");
        }
        else if(action.equals("android.intent.action.MEDIA_REMOVED")){
            System.out.println("sd卡被拔出");
        }
    }
}
```

```
<receiver android:name="com.leoyanblog.sdcradlistener.SDCardReceiver">
  <intent-filter >
    <action android:name="android.intent.action.MEDIA_MOUNTED"/>
    <action android:name="android.intent.action.MEDIA_UNMOUNTED"/>
    <action android:name="android.intent.action.MEDIA_REMOVED"/>
    <data android:scheme="file"/>
  </intent-filter>
</receiver>
```

- 监听应用安装变化

```
public class AppReceiver extends BroadcastReceiver {
    @Override
    public void onReceive(Context context, Intent intent) {
        //区分接收到的是哪种广播
        String action = intent.getAction();
        //获取广播中包含的应用包名
        Uri uri = intent.getData();
        if(action.equals("android.intent.action.PACKAGE_ADDED")){
            System.out.println(uri + "被安装了");
        }
        else if(action.equals("android.intent.action.PACKAGE_REPLACED")){
            System.out.println(uri + "被更新了");
        }
        else if(action.equals("android.intent.action.PACKAGE_REMOVED")){
            System.out.println(uri + "被卸载了");
        }
    }
}
```

```
<receiver android:name="com.leoyanblog.app.AppReceiver">
  <intent-filter >
    <action android:name="android.intent.action.PACKAGE_ADDED"/>
    <action android:name="android.intent.action.PACKAGE_REPLACED"/>
    <action android:name="android.intent.action.PACKAGE_REMOVED"/>
    <data android:scheme="package"/>
   </intent-filter>
</receiver>
```

- 常见的 Action 常量

ACTION_TIME_CHANGED 系统时间被改变

ACTION_DATE_CHANGED 系统日期被改变

ACTION_TIMEZONE_CHANGED 系统时区被改变

ACTION_BOOT_COMPLETED 系统启动完成

ACTION_PACKAGE_ADDED 系统添加包

ACTION_PACKAGE_CHANGED 系统的包改变

ACTION_PACKAGE_REMOVED 系统的包被删除

ACTION_PACKAGE_RESTARTED 系统的包被重启

ACTION_PACKAGE_DATA_CLEARED 系统的包数据被清空

ACTION_BATTERY_CHANGED 电池电量改变

ACTION_BATTERY_LOW 电池电量低

ACTION_POWER_CONNECTED 系统连接电源

ACTION_POWER_DISCONNECTED 系统与电源断开

ACTION_SHUTDOWN：系统被关闭。

附录1、系统的Looper类

系统的Looper类和消息循环Looper.loop()

```
public class Looper {
    // 每个线程中的Looper对象其实是一个ThreadLocal，即线程本地存储(TLS)对象
    private static final ThreadLocal sThreadLocal = new ThreadLocal();
    // Looper内的消息队列
    final MessageQueue mQueue;
    // 当前线程
    Thread mThread;
    // 。。。其他属性

    // 每个Looper对象中有它的消息队列，和它所属的线程
    private Looper() {
        mQueue = new MessageQueue();
        mRun = true;
        mThread = Thread.currentThread();
    }
    // 我们调用该方法会在调用线程的TLS中创建Looper对象
    public static final void prepare() {
        if (sThreadLocal.get() != null) {
            // 试图在有Looper的线程中再次创建Looper将抛出异常
            throw new RuntimeException("Only one Looper may be created per thread");
        }
        sThreadLocal.set(new Looper());
    }
```

```
    public static final void loop() {
        Looper me = myLooper(); //得到当前线程Looper
        MessageQueue queue = me.mQueue; //得到当前looper的MQ
        Binder.clearCallingIdentity();
        finallong ident = Binder.clearCallingIdentity();
        while (true) {
            Message msg = queue.next(); // 取出message
            if (msg != null) {
                if (msg.target == null) { return;    }
                if (me.mLogging != null)
                    me.mLogging.println(">>>>> Dispatching to " + msg.target + ""
                            + msg.callback + ": " + msg.what);
                // 将处理工作交给message的target，即后面要讲的handler
                msg.target.dispatchMessage(msg);
                if (me.mLogging != null)  me.mLogging.println("<<<<< Finished to "
                                    + msg.target + "" + msg.callback);
                finallong newIdent = Binder.clearCallingIdentity();
                if (ident != newIdent) {
                    Log.wtf("Looper", "Thread identity changed from 0x"
                        + Long.toHexString(ident)
                        + " to 0x" + Long.toHexString(newIdent) + " while dispatching to "
                        + msg.target.getClass().getName() + ""
                        + msg.callback + " what=" + msg.what);
                }
                msg.recycle(); // 回收message资源
            }
        }
    }
    ...
}
```

在系统的MediaPlaybackActivity.Java中，我们可以看一下再OnCreate中的有这样的两句：

mAlbumArtWorker = new Worker(“album art worker”);

mAlbumArtHandler = new AlbumArtHandler(mAlbumArtWorker.getLooper());

```
private class Worker implements Runnable {
    private final Object mLock = new Object();
    private Looper mLooper;
    Worker(String name) {
        Thread t = new Thread(null, this, name);
        t.setPriority(Thread.MIN_PRIORITY);
        t.start();
        synchronized (mLock) {
            while (mLooper == null) {
                try {
                    mLock.wait();
                } catch (InterruptedException ex) {
                }
            }
        }
    }
    public Looper getLooper() { return mLooper; }
    public void run() {
        synchronized (mLock) {
            Looper.prepare();
            mLooper = Looper.myLooper();
            mLock.notifyAll();
        }
        Looper.loop();
    }
    public void quit() {     mLooper.quit();     }
}
```