# Networking

# Networking

Early handheld devices gave us mobility

But with limited connectivity

Today’s devices have greater mobility and connectivity

Many applications use data and services via the Internet

# Networking

Android includes multiple networking support classes, e.g.,

java.net – (Socket, URL)

org.apache - (HttpRequest, HttpResponse)

android.net – (URI, AndroidHttpClient, AudioStream)

# Example Application

Application sends a request to a networked server for earthquake data

Then Displays the requested data

# Sending HTTP Requests

Socket

HttpURLConnection

AndroidHttpClient


22:24
NetworkingSockets
Load Data
HTTP/1.1 200 OKDate: Sat, 28 Sep 2013 02:23:57 GMTServer: Apache/2.2.17 (Linux/SUSE)Cache-Control: no-cacheAccess-Control-Allow-Origin: *Connection: closeTransfer-Encoding: chunkedContent-Type: application/json;charset=UTF-84bc{"earthquakes":[{"eqid":"c0001xgp","magnitude":8.8,"lng":142.369,"src":"us","datetime":"2011-03-11 04:46:23","depth":24.4,"lat":38.322},{"eqid":"c000905e","magnitude":8.6,"lng":93.0632,"src":"us","datetime":"2012-04-11 06:38:37","depth":22.9,"lat":2.311},{"

# NetworkingSockets

```
public class NetworkingSocketsActivity extends Activity {
    TextView mTextView;

    @Override
    public void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.main);
        mTextView = (TextView) findViewById(R.id.textView1);

        final Button loadButton = (Button) findViewById(R.id.button1);
        loadButton.setOnClickListener(new OnClickListener() {

            @Override
            public void onClick(View v) {
                new HttpGetTask().execute();

            }
        });
    }
```

# NetworkingSockets

```
private class HttpGetTask extends AsyncTask<Void, Void, String> {

    private static final String HOST = "api.geonames.org";

    // Get your own user name at http://www.geonames.org/login
    private static final String USER_NAME = "aporter";
    private static final String HTTP_GET_COMMAND = "GET /earthquakesJSON?north=44.1&south=-9.9&east=-22.4&west=55.2&username="
            + USER_NAME
            + " HTTP/1.1"
            + "\n"
            + "Host: "
            + HOST
            + "\n"
            + "Connection: close" + "\n\n";

    private static final String TAG = "HttpGet";
```

# NetworkingSockets

```java
@Override
protected String doInBackground(Void... params) {
    Socket socket = null;
    String data = "";

    try {
        socket = new Socket(HOST, 80);
        PrintWriter pw = new PrintWriter(new OutputStreamWriter(
                socket.getOutputStream()), true);
        pw.println(HTTP_GET_COMMAND);

        data = readStream(socket.getInputStream());

    } catch (UnknownHostException exception) {
        exception.printStackTrace();
    } catch (IOException exception) {
        exception.printStackTrace();
    } finally {
        if (null != socket)
            try {
                socket.close();
            } catch (IOException e) {
                Log.e(TAG, "IOException");
            }
    }
    return data;
}
```

# NetworkingSockets

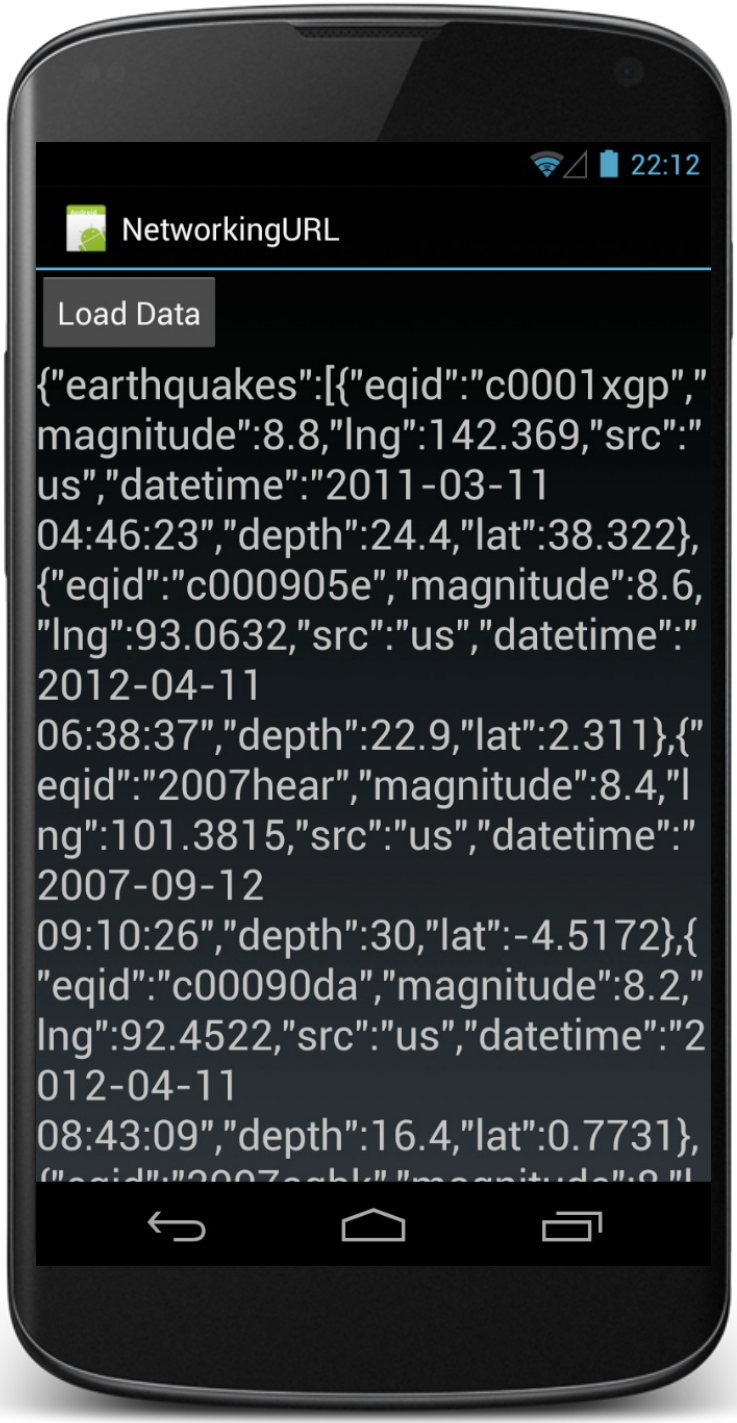
```
@Override
protected void onPostExecute(String result) {
    mTextView.setText(result);
}

private String readStream(InputStream in) {
    BufferedReader reader = null;
    StringBuffer data = new StringBuffer();
    try {
        reader = new BufferedReader(new InputStreamReader(in));
        String line = "";
        while ((line = reader.readLine()) != null) {
            data.append(line);
        }
    } catch (IOException e) {
        Log.e(TAG, "IOException");
    } finally {
        if (reader != null) {
            try {
                reader.close();
            } catch (IOException e) {
                Log.e(TAG, "IOException");
            }
        }
    }
    return data.toString();
}
```


22:24
NetworkingSockets
Load Data
HTTP/1.1 200 OKDate: Sat, 28 Sep 2013 02:23:57 GMTServer: Apache/2.2.17 (Linux/SUSE)Cache-Control: no-cacheAccess-Control-Allow-Origin: *Connection: closeTransfer-Encoding: chunkedContent-Type: application/json;charset=UTF-84bc{"earthquakes":[{"eqid":"c0001xgp","magnitude":8.8,"lng":142.369,"src":"us","datetime":"2011-03-11 04:46:23","depth":24.4,"lat":38.322},{"eqid":"c000905e","magnitude":8.6,"lng":93.0632,"src":"us","datetime":"2012-04-11 06:38:37","depth":22.9,"lat":2.311},{"

# HttpURLConnection

Higher-level than Sockets

Less Flexible API than HttpAndroidClient


22:12
NetworkingURL
Load Data
{"earthquakes":[{"eqid":"c0001xgp","
magnitude":8.8,"lng":142.369,"src":"
us","datetime":"2011-03-11
04:46:23","depth":24.4,"lat":38.322},
{"eqid":"c000905e","magnitude":8.6,
"lng":93.0632,"src":"us","datetime":"
2012-04-11
06:38:37","depth":22.9,"lat":2.311},{"
eqid":"2007hear","magnitude":8.4,"l
ng":101.3815,"src":"us","datetime":"
2007-09-12
09:10:26","depth":30,"lat":-4.5172},{
"eqid":"c00090da","magnitude":8.2,"
lng":92.4522,"src":"us","datetime":"2
012-04-11
08:43:09","depth":16.4,"lat":0.7731},

# NetworkingURL

```
public class NetworkingURLActivity extends Activity {
    private TextView mTextView;

    @Override
    public void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);

        setContentView(R.layout.main);
        mTextView = (TextView) findViewById(R.id.textView1);

        final Button loadButton = (Button) findViewById(R.id.button1);
        loadButton.setOnClickListener(new OnClickListener() {

            @Override
            public void onClick(View v) {
                new HttpGetTask().execute();
            }
        });
    }
```

# NetworkingURL

```
private class HttpGetTask extends AsyncTask<Void, Void, String> {

    private static final String TAG = "HttpGetTask";

    // Get your own user name at http://www.geonames.org/login
    private static final String USER_NAME = "aporter";
    private static final String URL = "http://api.geonames.org/earthquakesJSON?north=44.1&south=-9.9&east=-22.4&west=55.2&username="
            + USER_NAME;

    @Override
    protected String doInBackground(Void... params) {
        String data = "";
        HttpURLConnection httpUrlConnection = null;

        try {
            httpUrlConnection = (HttpURLConnection) new URL(URL)
                    .openConnection();

            InputStream in = new BufferedInputStream(
                    httpUrlConnection.getInputStream());

            data = readStream(in);

        } catch (MalformedURLException exception) {
            Log.e(TAG, "MalformedURLException");
        } catch (IOException exception) {
            Log.e(TAG, "IOException");
        } finally {
            if (null != httpUrlConnection)
                httpUrlConnection.disconnect();
        }
        return data;
    }
```

# NetworkingURL

```
@Override
protected void onPostExecute(String result) {
    mTextView.setText(result);
}

private String readStream(InputStream in) {
    BufferedReader reader = null;
    StringBuffer data = new StringBuffer("");
    try {
        reader = new BufferedReader(new InputStreamReader(in));
        String line = "";
        while ((line = reader.readLine()) != null) {
            data.append(line);
        }
    } catch (IOException e) {
        Log.e(TAG, "IOException");
    } finally {
        if (reader != null) {
            try {
                reader.close();
            } catch (IOException e) {
                e.printStackTrace();
            }
        }
    }
    return data.toString();
}
```

# AndroidHttpClient

An implementation of Apache's DefaultHttpClient

Breaks HTTP Transaction into separate Request and Response Objects

# NetworkingAndroidHttpClient

```
public class NetworkingAndroidHttpClientActivity extends Activity {
    private TextView mTextView = null;

    @Override
    public void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.main);

        mTextView = (TextView) findViewById(R.id.textView1);

        final Button loadButton = (Button) findViewById(R.id.button1);
        loadButton.setOnClickListener(new OnClickListener() {
            @Override
            public void onClick(View v) {
                new HttpGetTask().execute();
            }
        });
    }
```

# NetworkingAndroidHttpClient

```
private class HttpGetTask extends AsyncTask<Void, Void, String> {

    // Get your own user name at http://www.geonames.org/login
    private static final String USER_NAME = "aporter";

    private static final String URL = "http://api.geonames.org/earthquakesJSON?north=44.1&south=-9.9&east=-22.4&west=55.2&username="
            + USER_NAME;

    AndroidHttpClient mClient = AndroidHttpClient.newInstance("");

    @Override
    protected String doInBackground(Void... params) {

        HttpGet request = new HttpGet(URL);
        ResponseHandler<String> responseHandler = new BasicResponseHandler();

        try {

            return mClient.execute(request, responseHandler);

        } catch (ClientProtocolException exception) {
            exception.printStackTrace();
        } catch (IOException exception) {
            exception.printStackTrace();
        }
        return null;
    }

    @Override
    protected void onPostExecute(String result) {

        if (null != mClient)
            mClient.close();

        mTextView.setText(result);

    }
}
```

# Processing Http Responses

Several popular formats including

JSON

XML

# JAVASCRIPT OBJECT NOTATION (JSON)

Intended to be a lightweight data interchange format

Data packaged in two types of structures:

Maps of key/value pairs

Ordered lists of values

See: http://www.json.org/

# Earthquake Data (JSON Output)

http://api.geonames.org/earthquakesJSON?north=44.1&south=-9.9&east=-22.4&west=55.2&username=demo

# Earthquake Data (JSON Output)


```
{"earthquakes”: [
  {"eqid":"c0001xgp","magnitude":8.8,"lng":142.369,   "
    "src":"us”, "datetime":"2011-03-11 04:46:23","depth":"
     24.4,"lat":38.322}
  {"eqid":"2007hear","magnitude":8.4,"lng":101.3815,"
    "src":"us”,"datetime":"2007-09-12 09:10:26","depth":  "
    30,"lat":-4.5172},
   ...
   {"eqid":"2010xkbv","magnitude":7.5,"lng":91.9379,"
     "src":"us”,"datetime":"2010-06-12 17:26:50","depth":"
     35,"lat":7.7477}
  ]
}
```


22:17
NetworkingAndroidHttpClientJSON
magnitude:8.8,lat:38.322,lng:142.369
magnitude:8.6,lat:2.311,lng:93.0632
magnitude:8.4,lat:-4.5172,lng:101.3815
magnitude:8.2,lat:0.7731,lng:92.4522
magnitude:8,lat:-8.4528,lng:156.9567
magnitude:7.8,lat:-2.5265,lng:100.9638

# NetworkingAndroidHttpClientJSON

```
@Override
public void onCreate(Bundle savedInstanceState) {
    super.onCreate(savedInstanceState);
    new HttpGetTask().execute();
}

private class HttpGetTask extends AsyncTask<Void, Void, List<String>> {

    // Get your own user name at http://www.geonames.org/login
    private static final String USER_NAME = "aporter";

    private static final String URL = "http://api.geonames.org/earthquakesJSON?north=44.1&south=-9.9&east=-22.4&west=55.2&username="
            + USER_NAME;

    AndroidHttpClient mClient = AndroidHttpClient.newInstance("");

    @Override
    protected List<String> doInBackground(Void... params) {
        HttpGet request = new HttpGet(URL);
        JSONResponseHandler responseHandler = new JSONResponseHandler();
        try {
            return mClient.execute(request, responseHandler);
        } catch (ClientProtocolException e) {
            e.printStackTrace();
        } catch (IOException e) {
            e.printStackTrace();
        }
        return null;
    }

    @Override
    protected void onPostExecute(List<String> result) {
        if (null != mClient)
            mClient.close();
        setListAdapter(new ArrayAdapter<String>(
                NetworkingAndroidHttpClientJSONActivity.this,
                R.layout.list_item, result));
    }
}
```

# NetworkingAndroidHttpClientJSON

```
private class JSONResponseHandler implements ResponseHandler<List<String>> {

    private static final String LONGITUDE_TAG = "lng";
    private static final String LATITUDE_TAG = "lat";
    private static final String MAGNITUDE_TAG = "magnitude";
    private static final String EARTHQUAKE_TAG = "earthquakes";

    @Override
    public List<String> handleResponse(HttpResponse response)
            throws ClientProtocolException, IOException {
        List<String> result = new ArrayList<String>();
        String JSONResponse = new BasicResponseHandler()
                .handleResponse(response);
        try {

            // Get top-level JSON Object - a Map
            JSONObject responseObject = (JSONObject) new JSONTokener(
                    JSONResponse).nextValue();

            // Extract value of "earthquakes" key -- a List
            JSONArray earthquakes = responseObject
                    .getJSONArray(EARTHQUAKE_TAG);

            // Iterate over earthquakes list
            for (int idx = 0; idx < earthquakes.length(); idx++) {

                // Get single earthquake data - a Map
                JSONObject earthquake = (JSONObject) earthquakes.get(idx);

                // Summarize earthquake data as a string and add it to
                // result
                result.add(MAGNITUDE_TAG + ":"
                        + earthquake.get(MAGNITUDE_TAG) + ","
                        + LATITUDE_TAG + ":"
                        + earthquake.getString(LATITUDE_TAG) + ","
                        + LONGITUDE_TAG + ":"
                        + earthquake.get(LONGITUDE_TAG));
            }
        } catch (JSONException e) {
            e.printStackTrace();
        }
        return result;
    }
}
```

# eXtensible Markup Language (XML)

XML documents can contain markup & content

Markup encodes a description of the document's storage layout and logical structure

Content is everything else

See http://www.w3.org/TR/xml

# Earthquake Data (XML)

http://api.geonames.org/earthquakes?
north=44.1&south=-9.9&east=-22.4&"
west=55.2& username=demo

# Earthquake Data (XML)

```
<geonames>
  <earthquake>
    <src>us</src>
    <eqid>c0001xgp</eqid>
    <datetime>2011-03-11 04:46:23</datetime>
    <lat>38.322</lat>
    <lng>142.369</lng>
    <magnitude>8.8</magnitude>
    <depth>24.4</depth>
  </earthquake>
...
</geonames>
```

# Parsing XML

Several types of parsers available

DOM – Converts document into a tree of nodes

SAX – streaming with application callbacks

Pull – Application iterates over XML entries

# NetworkingAndroidHttpClientXML

```
class XMLResponseHandler implements ResponseHandler<List<String>> {

    private static final String MAGNITUDE_TAG = "magnitude";
    private static final String LONGITUDE_TAG = "lng";
    private static final String LATITUDE_TAG = "lat";
    private String mLat, mLng, mMag;
    private boolean mIsParsingLat, mIsParsingLng, mIsParsingMag;
    private final List<String> mResults = new ArrayList<String>();

    @Override
    public List<String> handleResponse(HttpResponse response)
            throws ClientProtocolException, IOException {
        try {

            // Create the Pull Parser
            XmlPullParserFactory factory = XmlPullParserFactory.newInstance();
            XmlPullParser xpp = factory.newPullParser();

            // Set the Parser's input to be the XML document in the HTTP Response
            xpp.setInput(new InputStreamReader(response.getEntity()
                    .getContent()));

            // Get the first Parser event and start iterating over the XML document
            int eventType = xpp.getEventType();

            while (eventType != XmlPullParser.END_DOCUMENT) {

                if (eventType == XmlPullParser.START_TAG) {
                    startTag(xpp.getName());
                } else if (eventType == XmlPullParser.END_TAG) {
                    endTag(xpp.getName());
                } else if (eventType == XmlPullParser.TEXT) {
                    text(xpp.getText());
                }
                eventType = xpp.next();
            }
            return mResults;
        } catch (XmlPullParserException e) {
        }
        return null;
    }
```

# NetworkingAndroidHttpClientXML

```
public void startTag(String localName) {
    if (localName.equals(LATITUDE_TAG)) {
        mIsParsingLat = true;
    } else if (localName.equals(LONGITUDE_TAG)) {
        mIsParsingLng = true;
    } else if (localName.equals(MAGNITUDE_TAG)) {
        mIsParsingMag = true;
    }
}

public void text(String text) {
    if (mIsParsingLat) {
        mLat = text.trim();
    } else if (mIsParsingLng) {
        mLng = text.trim();
    } else if (mIsParsingMag) {
        mMag = text.trim();
    }
}

public void endTag(String localName) {
    if (localName.equals(LATITUDE_TAG)) {
        mIsParsingLat = false;
    } else if (localName.equals(LONGITUDE_TAG)) {
        mIsParsingLng = false;
    } else if (localName.equals(MAGNITUDE_TAG)) {
        mIsParsingMag = false;
    } else if (localName.equals("earthquake")) {
        mResults.add(MAGNITUDE_TAG + ":" + mMag + "," + LATITUDE_TAG + ":"
                + mLat + "," + LONGITUDE_TAG + ":" + mLng);
        mLat = null;
        mLng = null;
        mMag = null;
    }
}
```

# Extra – Networking Permissions

Applications need permission to open network sockets

```
<uses-permission android:name="
    "android.permission.INTERNET" />
```