Networking in Android

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Network

- What's a network? Why network?

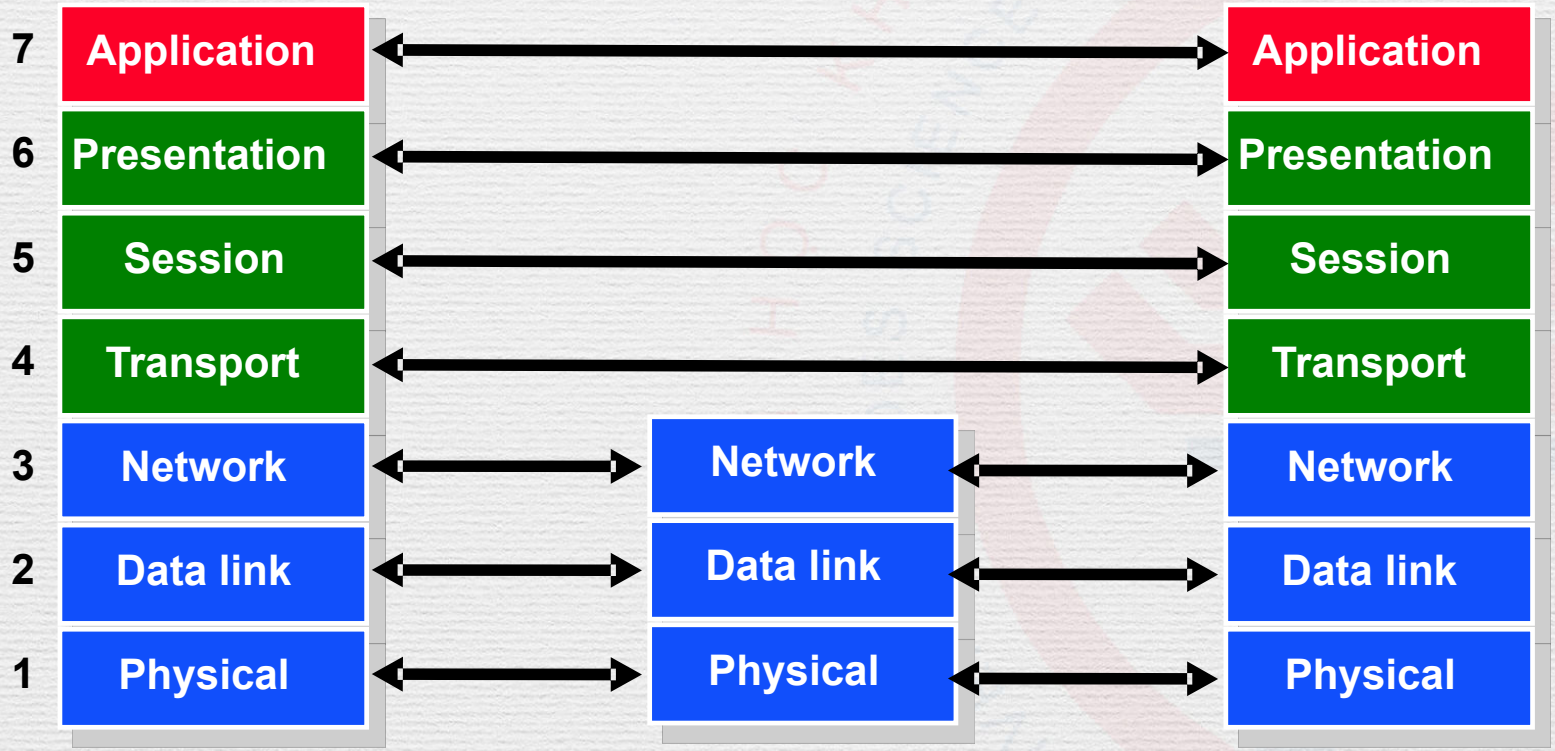
Network

- What's a network? Why network?
- OSI Model? TCP/IP?

Network

- What's a network? Why network?
- OSI Model? TCP/IP?
- How to make a request in JavaScript?

Network Layering



Networking in Android

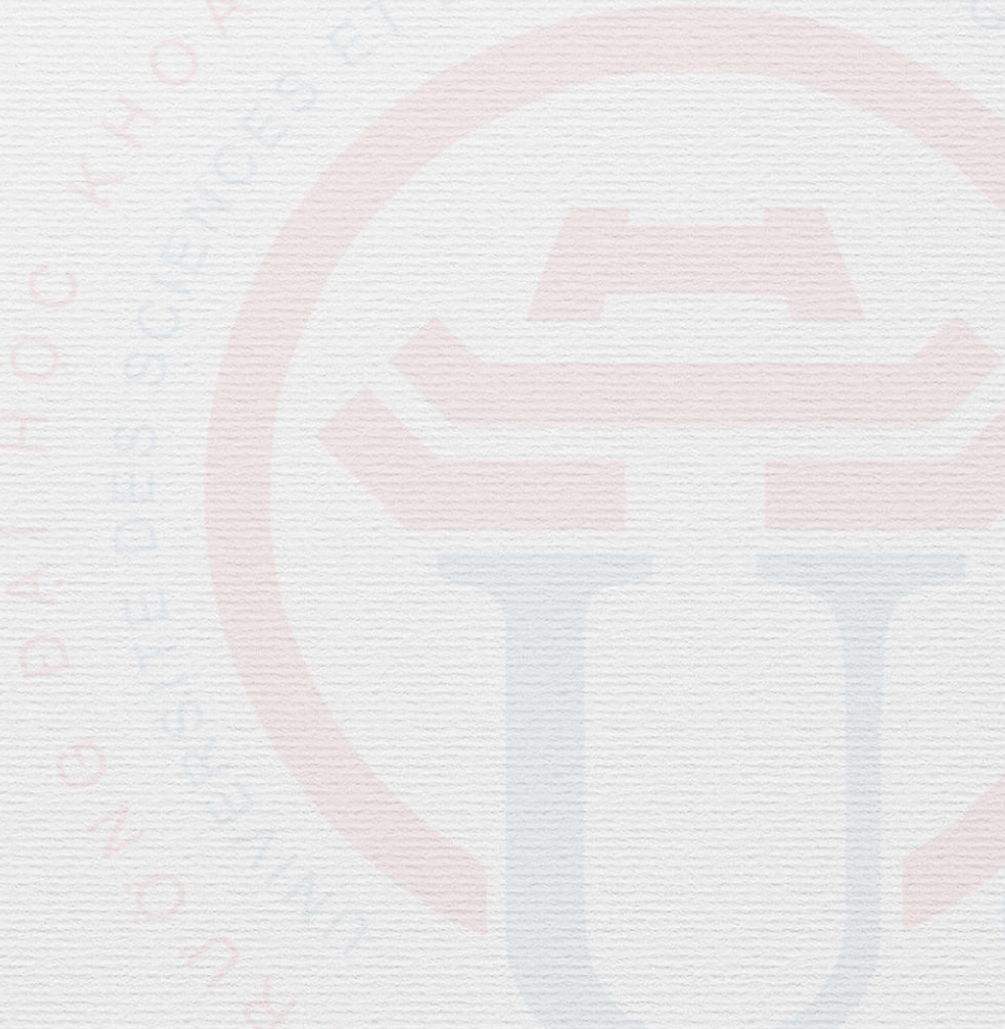
- Socket: TCP/UDP
- Protocol: HTTP / FTP / SIP / SMTP / IMAP / ...
- In this course
  - HTTP Client with JSON representation
  - Why?

Contents

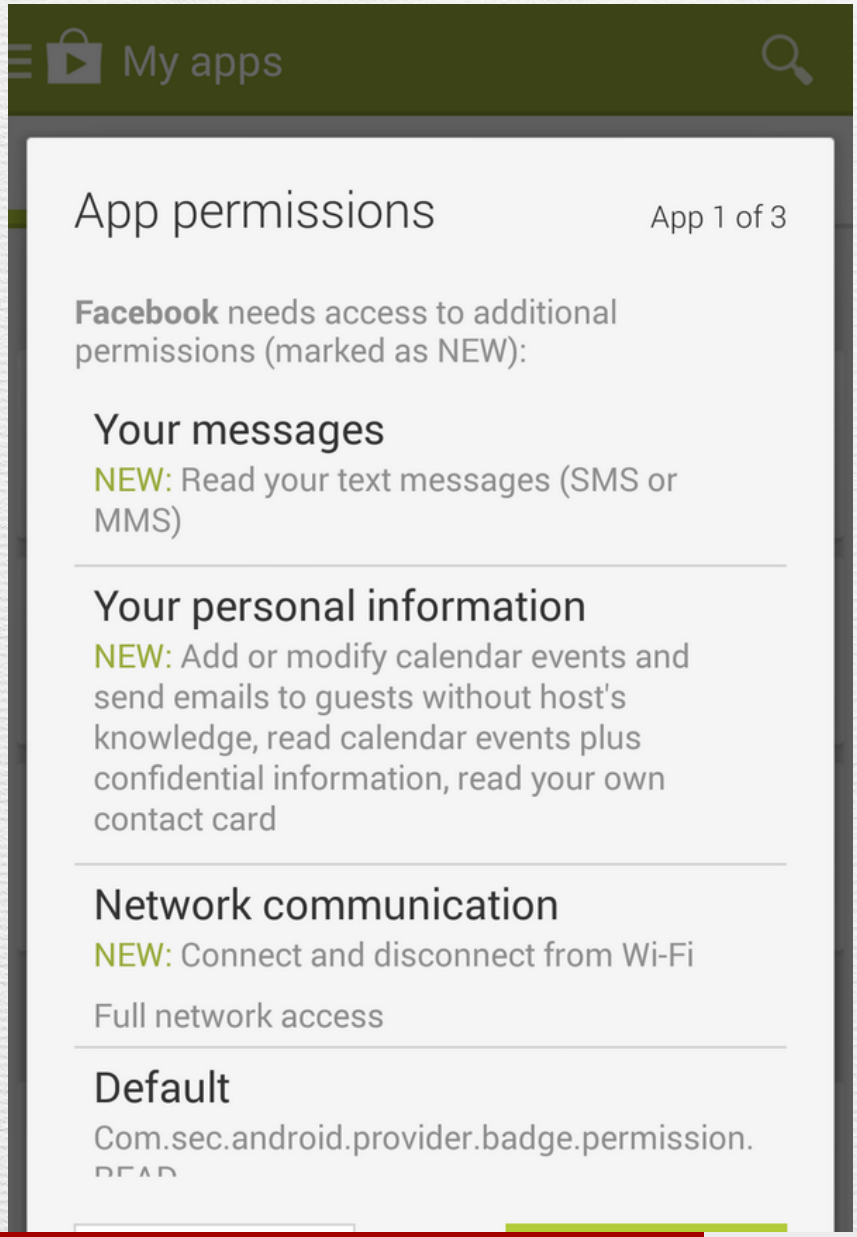
- Permissions
- Embedded package/class
- External library
- Data representation

Permissions

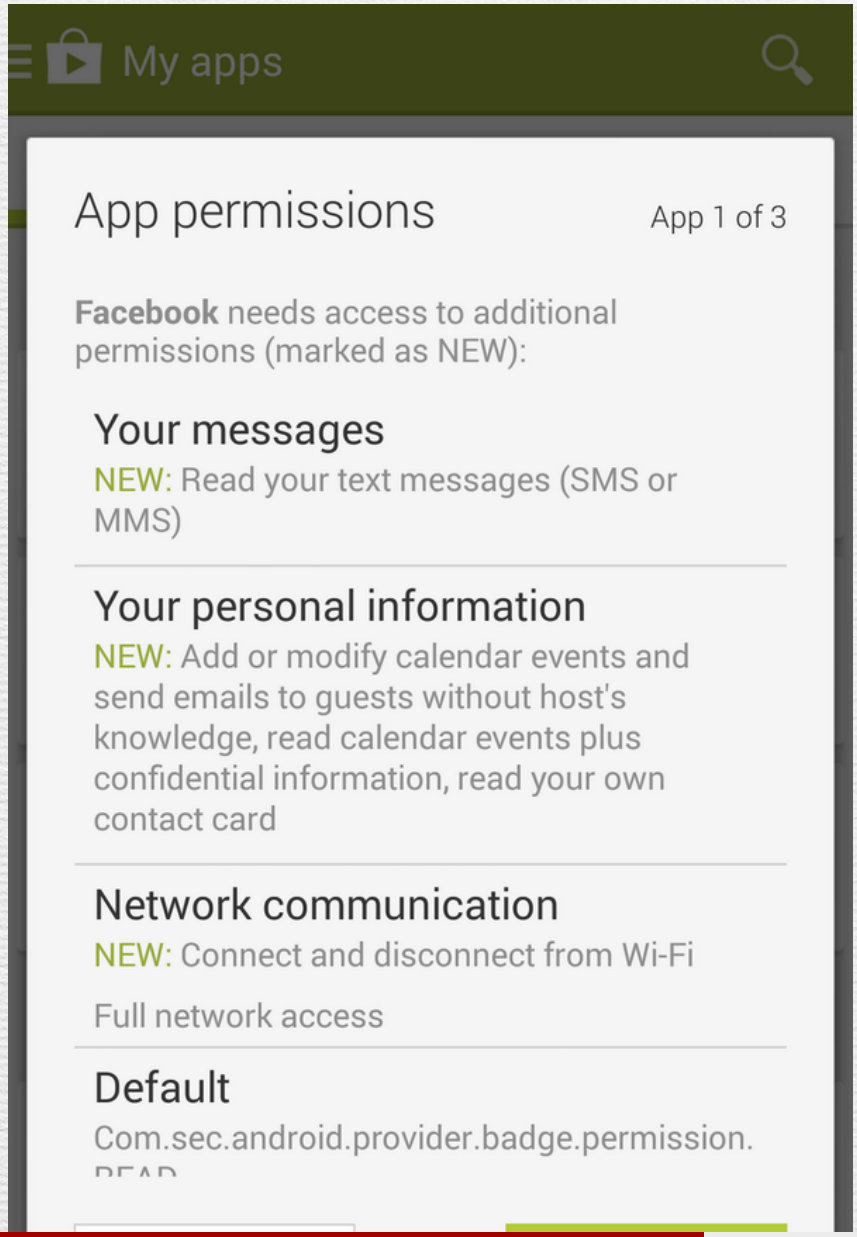
What?



What?


My apps
App permissions
App 1 of 3
Facebook needs access to additional permissions (marked as NEW):
Your messages
NEW: Read your text messages (SMS or MMS)
Your personal information
NEW: Add or modify calendar events and send emails to guests without host's knowledge, read calendar events plus confidential information, read your own contact card
Network communication
NEW: Connect and disconnect from Wi-Fi
Full network access
Default
Com.sec.android.provider.badge.permission.

What?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App permissions
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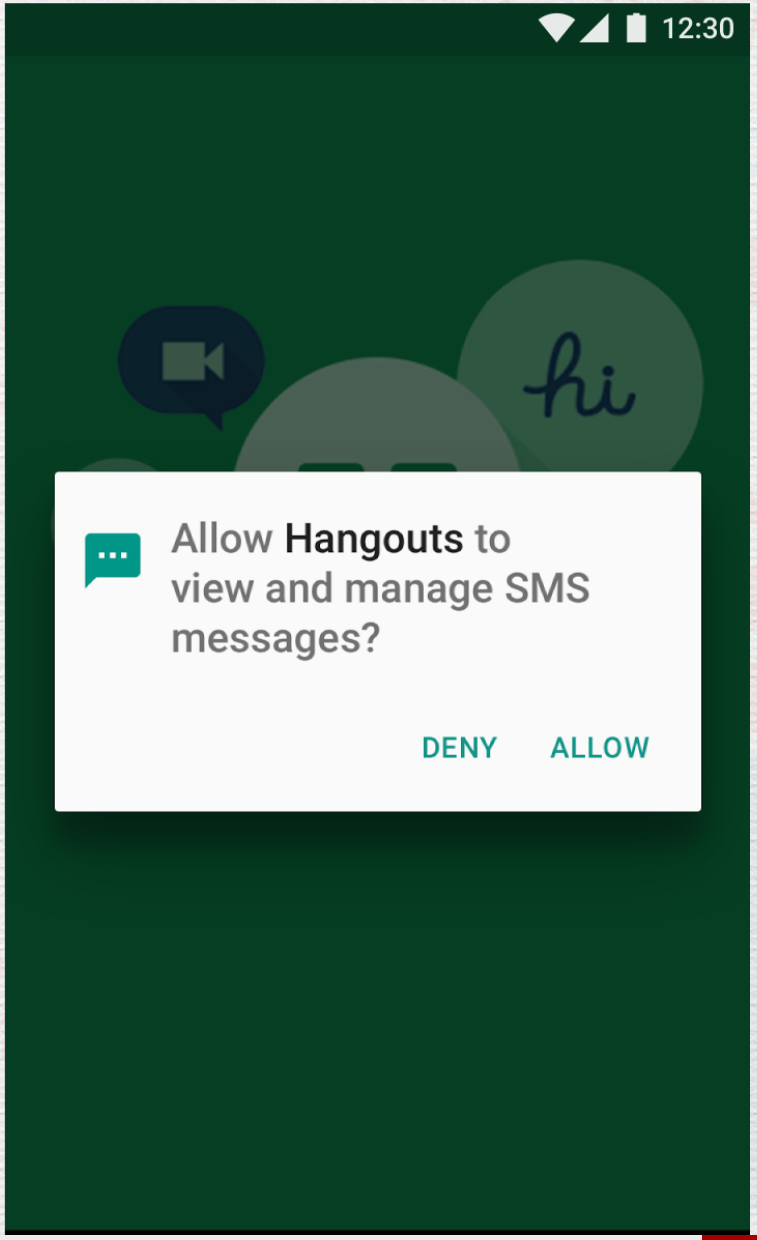
Facebook needs access to additional permissions (marked as NEW):
Your messages
NEW: Read your text messages (SMS or MMS)
Your personal information
NEW: Add or modify calendar events and send emails to guests without host's knowledge, read calendar events plus confidential information, read your own contact card
Network communication
NEW: Connect and disconnect from Wi-Fi
Full network access
Default
Com.sec.android.provider.badge.permission.


12:30
hi
Allow Hangouts to view and manage SMS messages?
DENY
ALLOW

What?

- Android has privilege-separation
- Sandboxing
  - System user ID
  - System group ID
- Specific actions require permissions

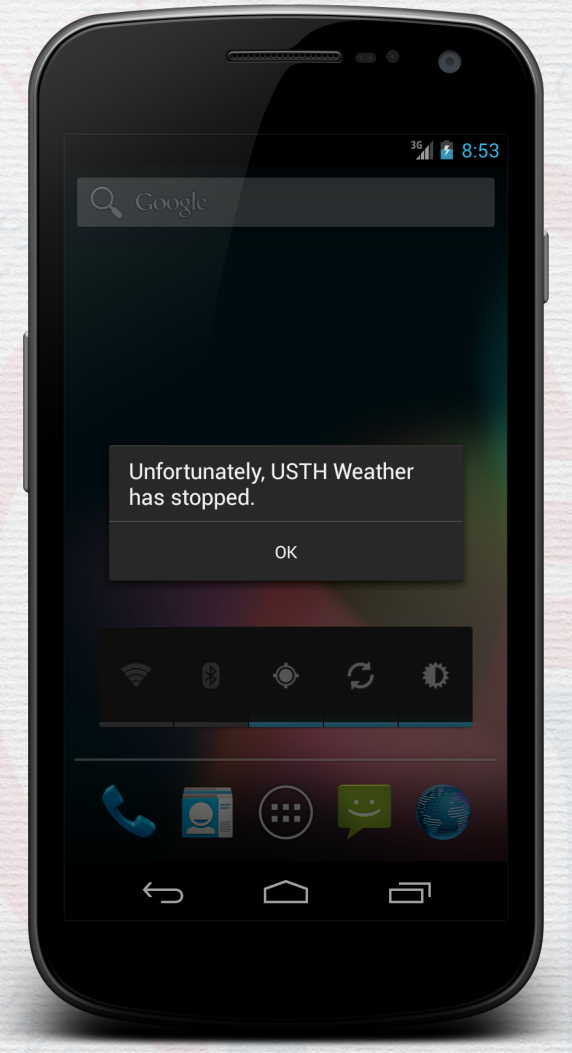
Why?

- Privacy is an important aspect
- Permission is a way to implement/improve security and privacy
- Each "sensitive" action requires a separated permission
  - Read external storage
  - Write external storage
  - Read contact list
  - ...

Why?

What happens if you don't have permission?

```
[138] NetworkDispatcher.run: Unhandled exception
java.lang.SecurityException: Permission denied
(missing INTERNET permission?)
    at java.net.InetAddress.lookupHostByName(InetAddress.java:464)
    at java.net.InetAddress.getAllByNameImpl(InetAddress.java:252)
    at java.net.InetAddress.getAllByName(InetAddress.java:215)
```



How?

Marshmallow+ has two main levels of permissions:

- Normal: no effect on user privacy, requires user confirmation
- "Dangerous": affect user privacy or device operations, requires confirmation

How?

- Normal level
  - Internet access
  - Read network state
  - Set timezone, set wallpaper...

How?

- Normal level
  - Internet access
  - Read network state
  - Set timezone, set wallpaper...
- Dangerous level
  - Read/write external storage
  - Access contact list
  - Access phone (make phone calls, receive calls, call log)
  - Send / receive SMS
  - Calendar, events
  - Microphone
  - Camera

How?

- Define what permissions are needed in the manifest
- For internet access

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

How?

- Define what permissions are needed in the manifest
- For internet access

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

- Normal permission, so no need special treatment
  - Request permissions at runtime
  - or reducing `targetSdkVersion`

Embedded package

Embedded package

- java.net
  - java.net.URL
  - java.net.HttpURLConnection
- java.io.InputStream

Embedded package

1. Create URL from string
2. Make a request to server
3. Receive response
4. Process response

Embedded package

1. **Create URL from string**

```
URL url = new URL("http://ict.usth.edu.vn/wp-content/" +
    "uploads/usth/usthlogo.png");
```

2. Make a request to server
3. Receive response
4. Process response

Embedded package

1. Create URL from string
2. **Make a request to server**

```
HttpURLConnection connection =
    (HttpURLConnection) url.openConnection();
connection.setRequestMethod("GET");
connection.setDoInput(true);
// allow reading response code and response dataconnection.
connection.connect();
```

3. Receive response
4. Process response

Embedded package

1. Create URL from string
2. Make a request to server
3. **Receive response**

```
int response = connection.getResponseCode();
Log.i("USTHWeather", "The response is: " + response);
InputStream is = connection.getInputStream();
```

4. Process response

Embedded package

1. Create URL from string
2. Make a request to server
3. Receive response
4. **Process response**
   - Different response type requires different data treatment
   - Image: transform to bitmap
   - JSON/XML : parsing (later...)

Embedded package: image response

- Decode data to bitmap

```
Bitmap bitmap = BitmapFactory.decodeStream(is);
```

Embedded package: image response

- Decode data to bitmap

```
Bitmap bitmap = BitmapFactory.decodeStream(is);
```

- Show it

```
ImageView logo = (ImageView) findViewById(R.id.logo);
logo.setImageBitmap(bitmap);
```

Embedded package: image response

- Decode data to bitmap

```
Bitmap bitmap = BitmapFactory.decodeStream(is);
```

- Show it

```
ImageView logo = (ImageView) findViewById(R.id.logo);
logo.setImageBitmap(bitmap);
```

- Don't forget to disconnect

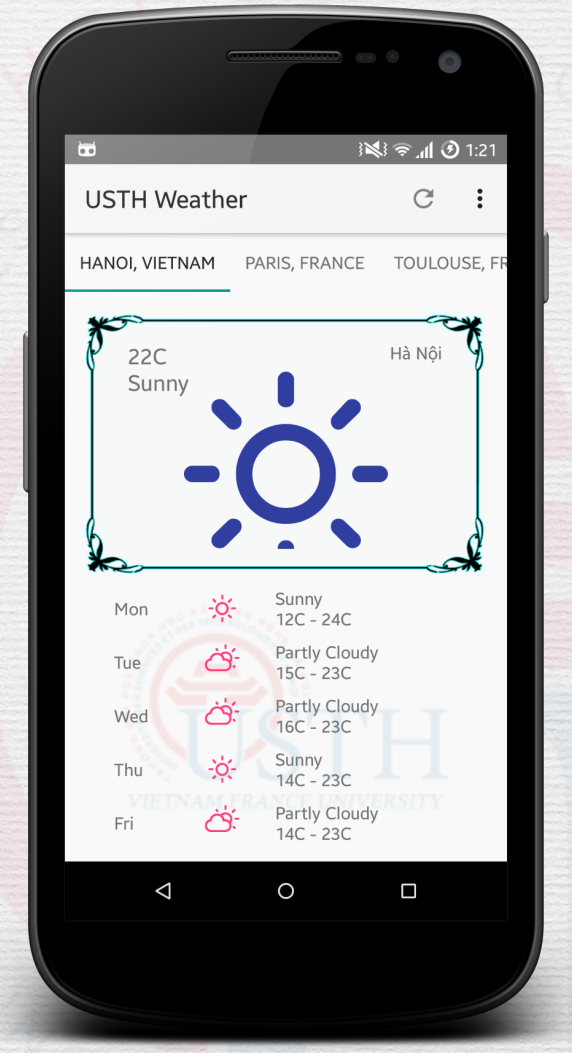
```
connection.disconnect();
```

Embedded package: recap

```
// initialize URL
URL url = new URL("http://ict.usth.edu.vn/wp-content/" +
    "uploads/usth/usthlogo.png");

// Make a request to server
HttpURLConnection connection =
    (HttpURLConnection) url.openConnection();
connection.setRequestMethod("GET");
connection.setDoInput(true);
// allow reading response code and response dataconnection.
connection.connect();

// Receive response
int response = connection.getResponseCode();
Log.i("USTHWeather", "The response is: " + response);
InputStream is = connection.getInputStream();

// Process image response
Bitmap bitmap = BitmapFactory.decodeStream(is);
ImageView logo = (ImageView) findViewById(R.id.logo);
logo.setImageBitmap(bitmap);

connection.disconnect();
```

Practical Work 15

- «Upgrade» your previous AsyncTask
- Perform a **real** network request to USTH's server
  - Download USTH logo
  - Show it on an ImageView of ForecastFragment



Embedded package

- Limitation?
  - «A lot» of code
  - No queue
  - No cache (mem-based and disk-based)

Embedded package

- How can we improve?
- «A lot» of code
- No queue
- No cache

Embedded package

- How can we improve?

- «A lot» of code
- No queue
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→

Embedded package

- How can we improve?

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→

- Code reuse

Embedded package

- How can we improve?

- «A lot» of code
- No queue
- No cache

$\rightarrow$

- Code reuse
- Make a queue

Embedded package

- How can we improve?

- «A lot» of code
- No queue
- No cache

$\rightarrow$

- Code reuse
- Make a queue
- Make a cache manager

Embedded package

That's **too much**

Embedded package

That's **too much**

Re-invent the wheel

Embedded package

That's **too much**

Re-invent the wheel

There should be someone who has **already** done those

Embedded package

External Library

External Library

Volley

View **introduction** on YouTube

Volley: What?

- An Android HTTP Client library
- Made within AOSP [Android OpenSource Project]
- The wheel
  - Doesn't need to be reinvented ☺
  - Reuse

Volley: Why?

- Simple to use
- Powerful
- Extendable
- Cache

Volley: Why?

- Simple to use
- Powerful
- Extendable
- Cache
- Maintained by Google ☺

Volley: How?

- Add INTERNET permission, if you haven't done so
- Clone volley repository

```
git clone https://android.googlesource.com/platform/frameworks/volley
```

- Add volley as module
- Right click project, open module settings, "+"
- Import Gradle Project

Volley: How?

1. Create request queue (one per app)
2. Create request with listeners
3. Add request to queue

Volley: How?

1. **Create request queue (one per app)**

```
RequestQueue queue = Volley.newRequestQueue(context);
```

   - One per app. How?
2. Create request with listeners
3. Add request to queue

Volley: How?

1. Create request queue (one per app)
2. **Create request with listeners**
   - Two main request types
   - ImageRequest
   - StringRequest

```
ImageRequest imageRequest = new ImageRequest(
    "http://ict.usth.edu.vn/wp-content/uploads/usth/usthlogo.png",
    listener, 0, 0, ImageView.ScaleType.CENTER,
    Bitmap.Config.ARGB_8888,null);
```

   - Listener: see next slide
3. Add request to queue

Volley: How?

1. Create request queue (one per app)
2. **Create request with listeners**
   - Listener
     - Is a callback
     - 2 types: error listener and response listener

```
Response.Listener<Bitmap> listener =
    new Response.Listener<Bitmap>() {
        @Override
        public void onResponse(Bitmap response) {
            ImageView iv = (ImageView) findViewById(R.id.logo);
            iv.setImageBitmap(response);
        }
    };
```

3. Add request to queue

Volley: How?

1. Create request queue (one per app)
2. Create request with listeners
3. **Add request to queue**

```
queue.add(imageRequest);
```

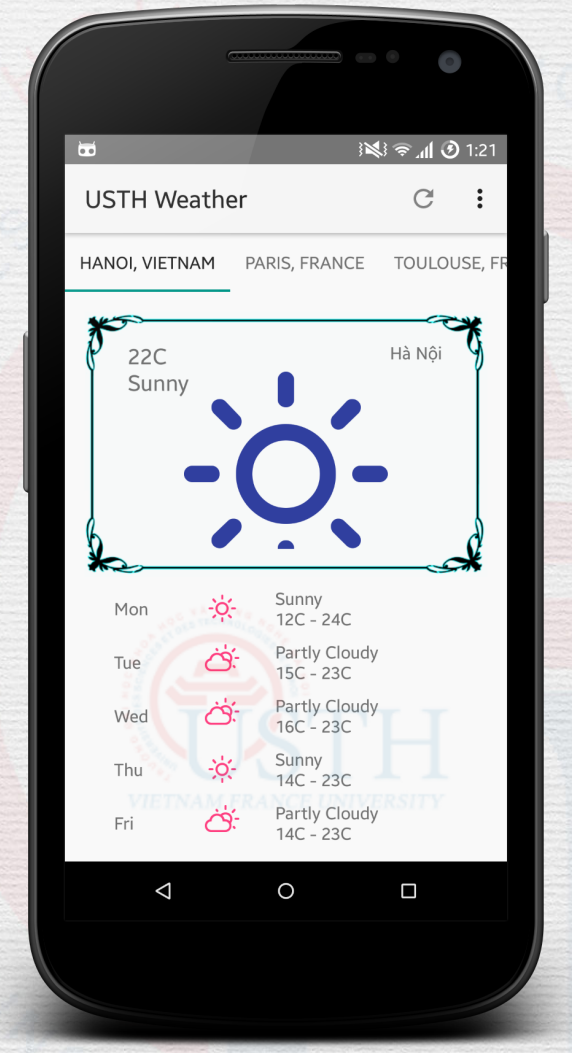
Profit.

Volley: Recap

```
// once, should be performed once per app instance
RequestQueue queue = Volley.newRequestQueue(context);

// a listener (kinda similar to onPostExecute())
Response.Listener<Bitmap> listener =
    new Response.Listener<Bitmap>() {
        @Override
        public void onResponse(Bitmap response) {
            ImageView iv = (ImageView) findViewById(R.id.logo);
            iv.setImageBitmap(response);
        }
    };

// a simple request to the required image
ImageRequest imageRequest = new ImageRequest(
    "http://ict.usth.edu.vn/wp-content/uploads/usth/usthlogo.png",
    listener, 0, 0, ImageView.ScaleType.CENTER,
    Bitmap.Config.ARGB_8888,null);

// go!
queue.add(imageRequest);
```

Practical Work 16

- «Upgrade» your previous AsyncTask HttpURLConnection to Volley
- Perform a **real** network request to USTH's server
  - Download USTH logo
  - Show it on an ImageView in the ForecastFragment



Data Representation

Data Represntation

- Previously, on MAD
  - Image URL + HttpURLConnection + AsyncTask → Bitmap
  - Image URL + ImageRequest + RequestQueue → Bitmap
- How about other kinds of data?

Data Represntation: Remind

- AJAX in Web Dev?

Data Represntation: Remind

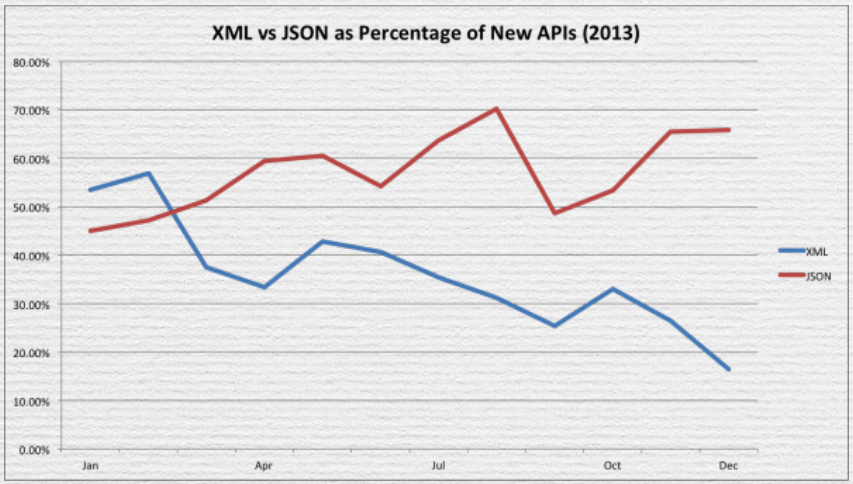
- AJAX in Web Dev?
- Do we really use the «X» in AJAX?

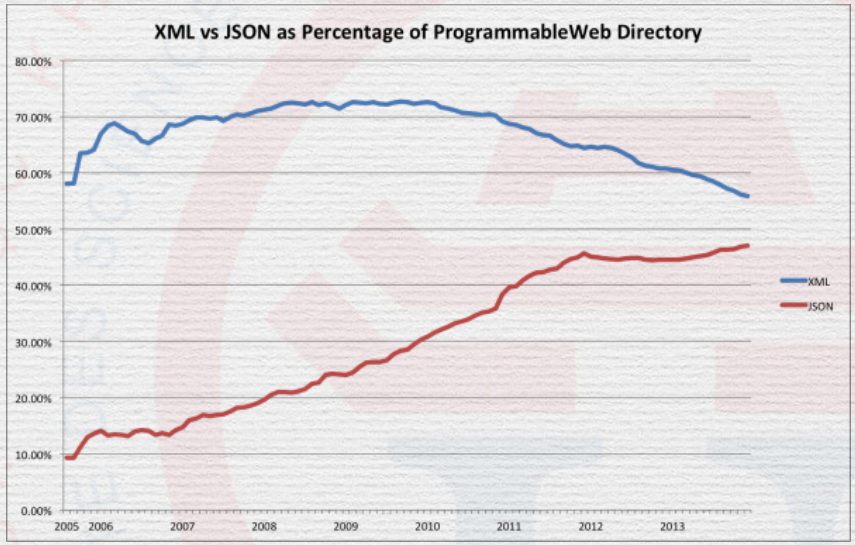
Data Represntation: Remind

- AJAX in Web Dev?
- Do we really use the «X» in AJAX?
- If not, what then?

Data Represntation: Trends

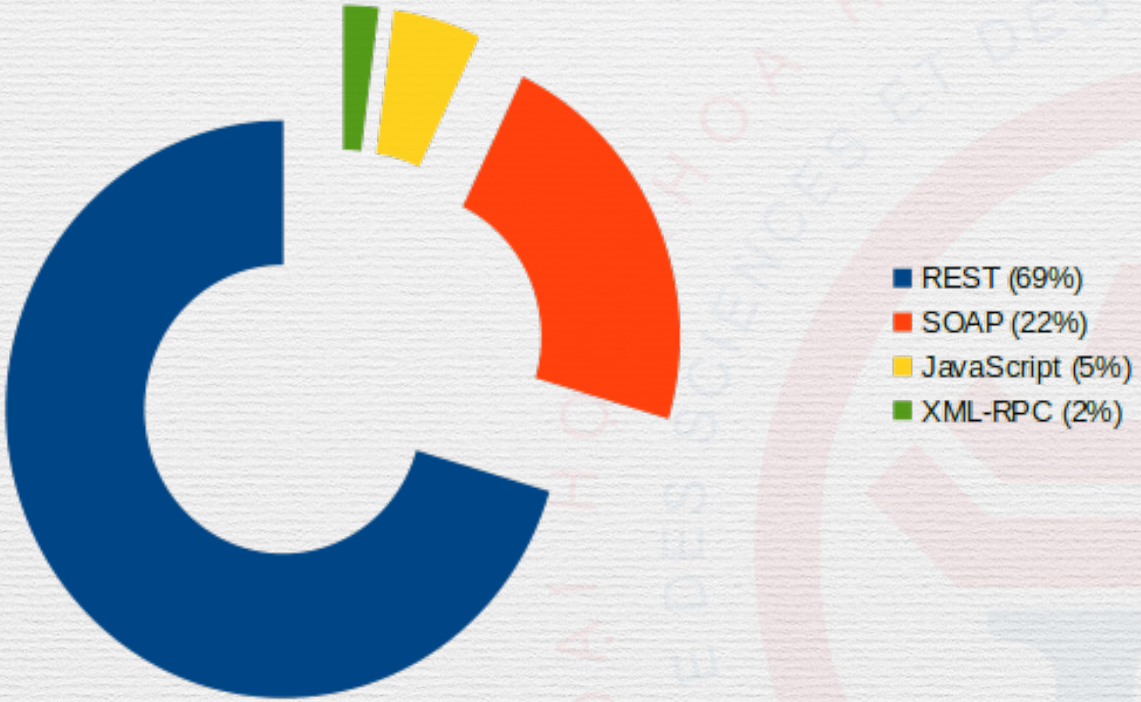
- XML vs JSON[1]





[1] **Source: ProgrammableWeb**

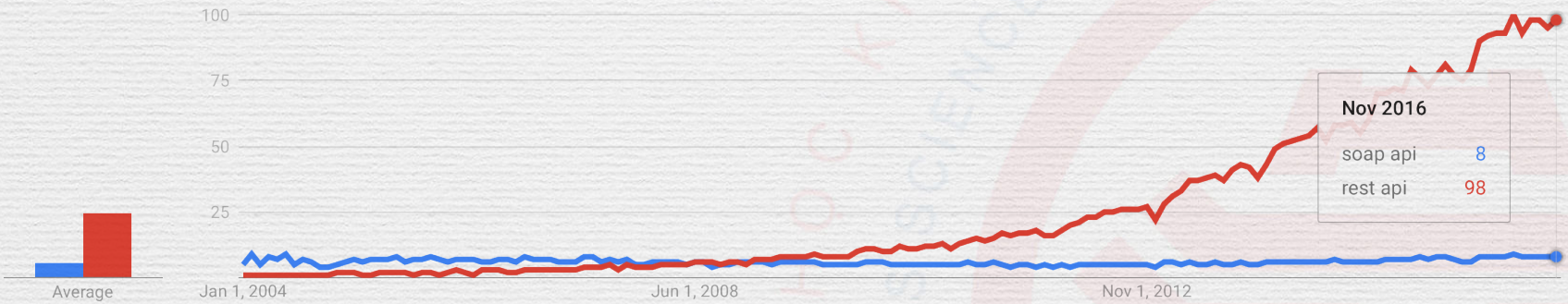
Data Representation



Backend APIs, March 2014[2]

[2] **Source: ProgrammableWeb**

Data Representation



Google Search trends, Nov 2016[3]

[3] **Source: Google Trends**

Data Representation

- JSON
  - Can represent structured data
  - Simple to use
  - Less verbose
  - Getting more attraction

Data Representation

```
{
 "query": {
  "count": 1,
  "created": "2016-11-28T08:09:31Z",
  "lang": "en-us",
  "results": {
   "channel": {
    "units": {
     "distance": "mi",
     "pressure": "in",
     "speed": "mph",
     "temperature": "F"
    },
   }
  }
 }
}
```

```
<?xml version="1.0" encoding="UTF-8"?>
<query xmlns:yahoo="http://www.yahooapis.com/v1/base.r
    yahoo:count="1" yahoo:created="2016-11-28T08:11:19
    <results>
        <channel>
            <language>en-us</language>
            <lastBuildDate>Mon, 28 Nov 2016 03:11 PM I
            <ttl>60</ttl>
            <yweather:location
                xmlns:yweather="http://xml.weather.yah
                city="H&agrave; N&#7897;i" country="Vi
            <yweather:wind
                xmlns:yweather="http://xml.weather.yah
                chill="75" direction="25" speed="7"/>
            ...
        </channel>
    </results>
</query>
```

Data Representation

- Yahoo Weather service

Data Representation

- Yahoo Weather service
- JSON: 2883 bytes

Data Representation

- Yahoo Weather service
- JSON: 2883 bytes
- XML: 4412 bytes

JSON: Examples

```
{
    "title": "Yahoo! Weather",
    "width": "142",
    "height": "18",
    "link": "http://weather.yahoo.com",
    "url": "http://l.yimg.com/a/i/brand/purplelogo//uh/us/r
}
```

JSON: How to get data

- Getting JSON data from server: just strings...

```
StringRequest request = new StringRequest(url,
    new Response.Listener<String>() {
        @Override
        public void onResponse(String response) {
            Log.i("USTHWeather", "Json response " + response);
        }
    },
    new Response.ErrorListener() {
        @Override
        public void onErrorResponse(VolleyError error) {
        }
    });
```

JSON: Parsing

- Built-in JSONObject / JSONArray
- Google's GSON
- JsonPath
- and many more... (check github!)

JSON: Parsing using built-in JSONObject / JSONArray

- JSON data

```
{
    "title": "Yahoo! Weather",
    "width": "142",
    "height": "18",
    ...
}
```

- Java code:

```
JSONObject obj = new JSONObject(response);
String titleValue = obj.getString("title");
JSONObject subObject = obj.getJSONObject("location");
```

Practical Work 17

- In your WeatherFragment:
  - Ask Yahoo for real weather
  - Decode its Json data
  - Display on your Fragment
  - Reference:
    - https://developer.yahoo.com/weather/