C2DM

Cloud to Device Messaging

Push!

Instant notifications on Android through C2DM

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In this talk

- What are push notifications and how do they work
- Differences between Android and iOS
- Client implementation of Android C2DM
- Tips & tricks

Push notifications

What and why?

Push notifications

- Received „instantly” by the device
  - Sent by some remote server, relayed via **push server**
- Contain small amount of information
  - More like wake-up call rather than actual message
- Handled mostly by the device OS
  - Long-lived, high timeout connection to the push server
  - Exposed by system API to apps running on the device

Benefits

- Avoid constant polling of the remote server
  - Saves bandwith and reduces battery use
- Receive notifications outside of synch. cycles
  - User can be notified immediately
- Handle events when application is not running
  - Platform-specific restrictions apply

Applications

- Asynchronous messaging
  - Most notably e-mail
- Social network updates
  - Facebook, Twitter, Foursquare, …
- Prospective searching
  - RSS readers, news from specialized sources, …
- Games
  - Especially multiplayer and/or time-dependant games
- Software updates

- …and many more

Push notifications

How?

Pushes… how do they work?

Mobile device

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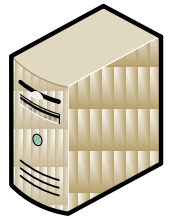
Mobile device



Remote server

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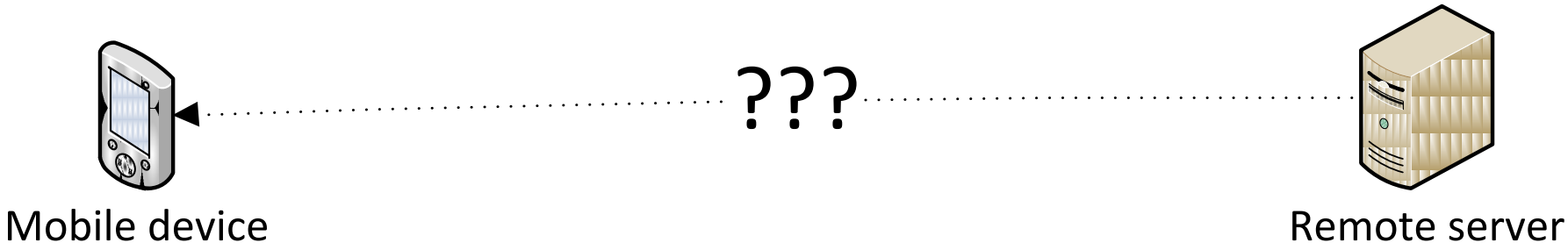

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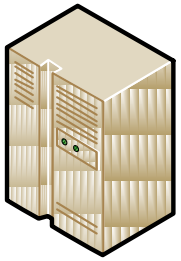
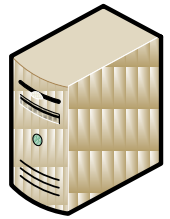


Push server

Mobile device



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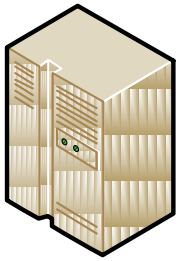

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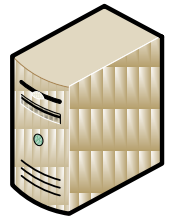
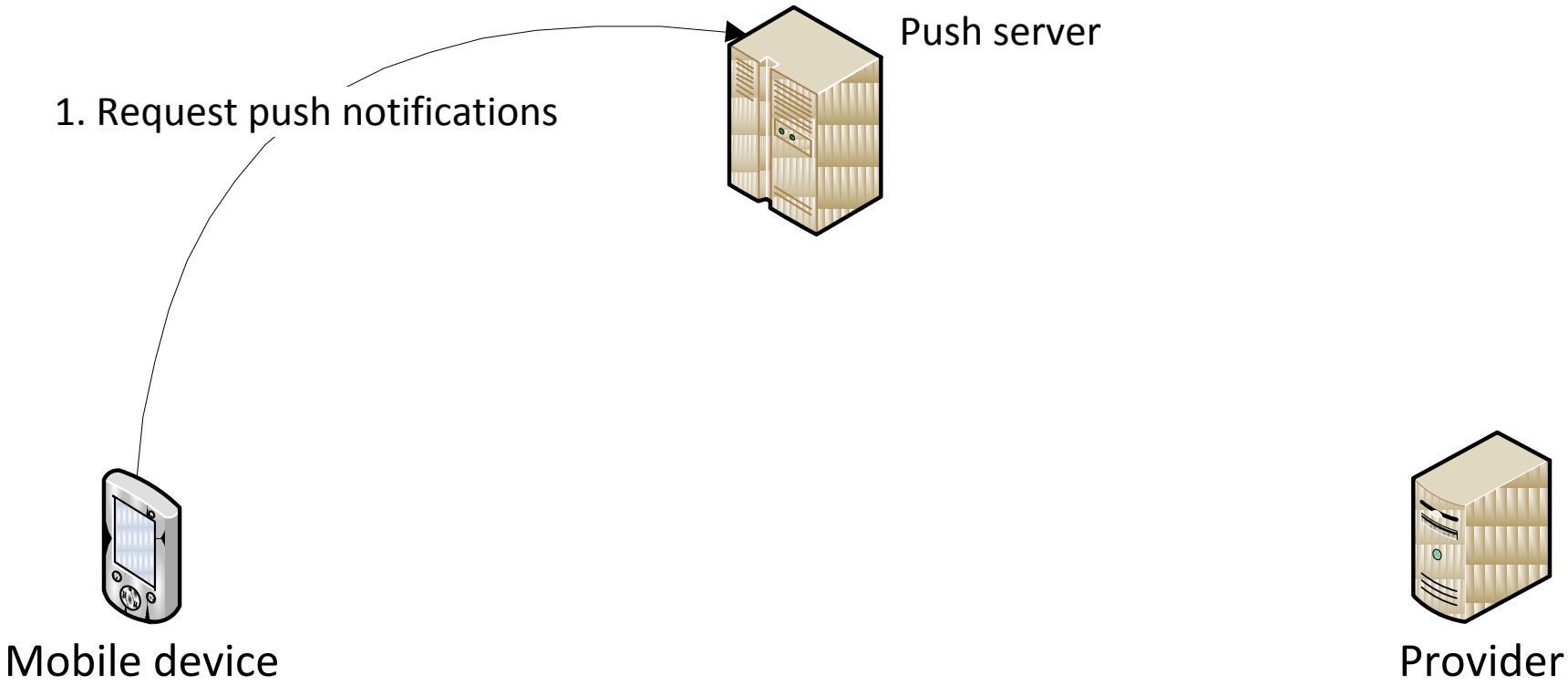


Provider

Pushes… how do they work?



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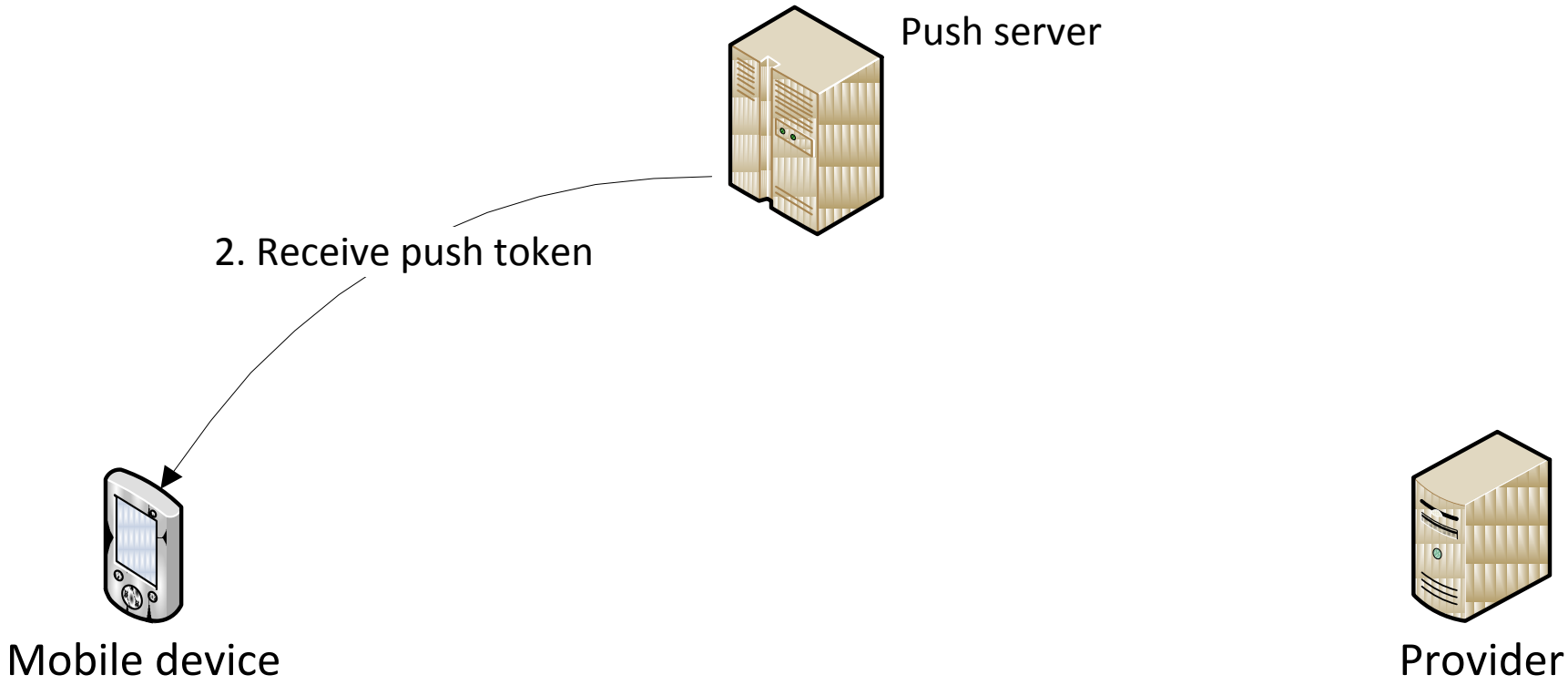

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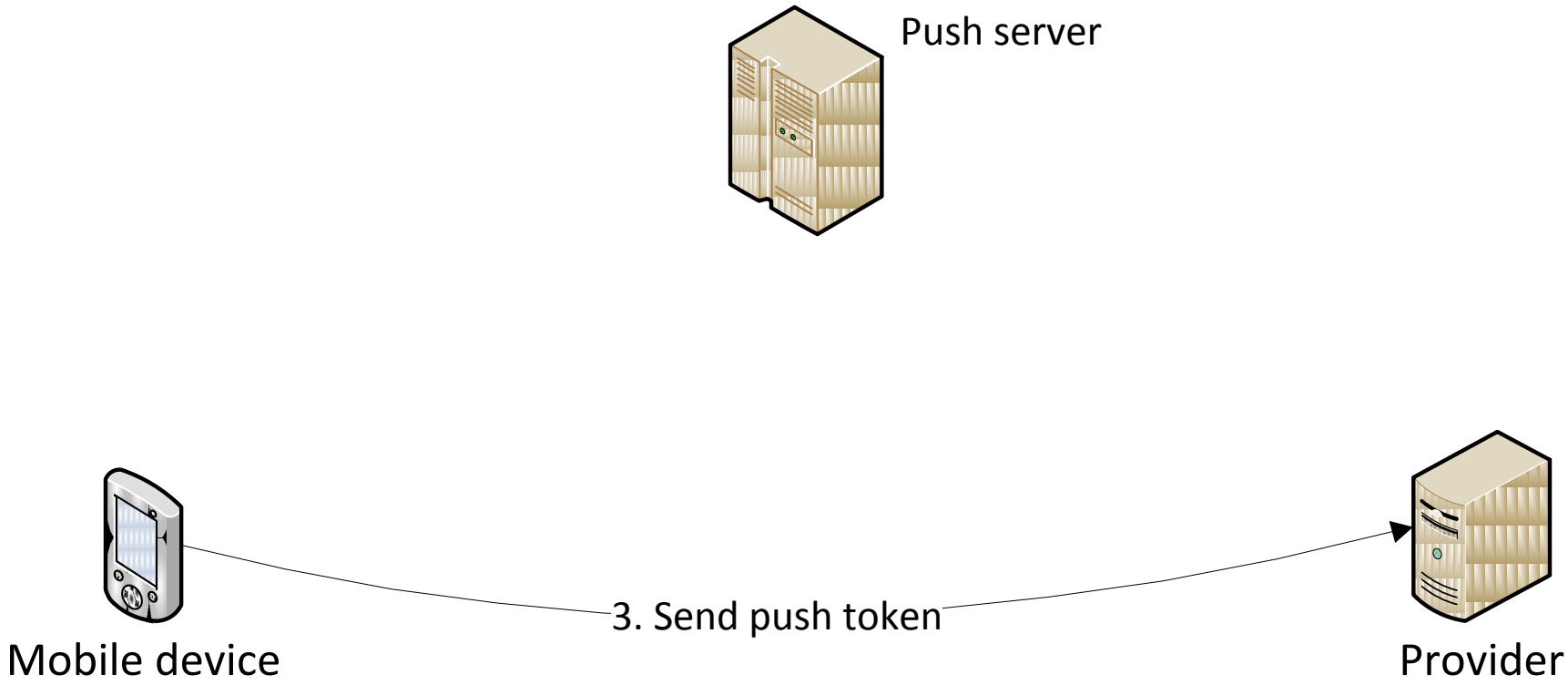

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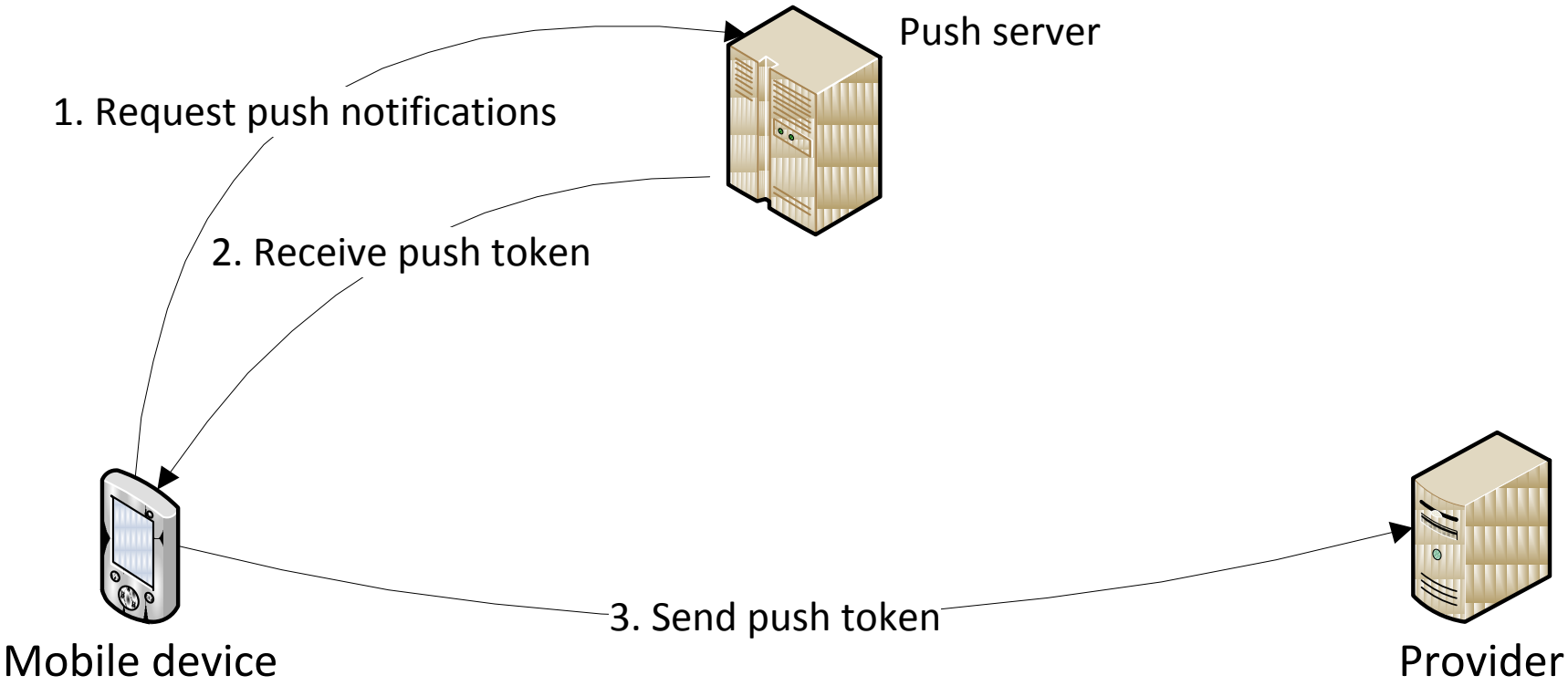

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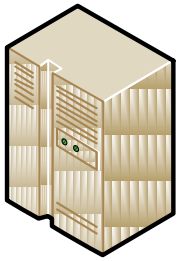

Push server

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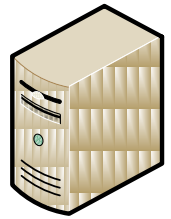

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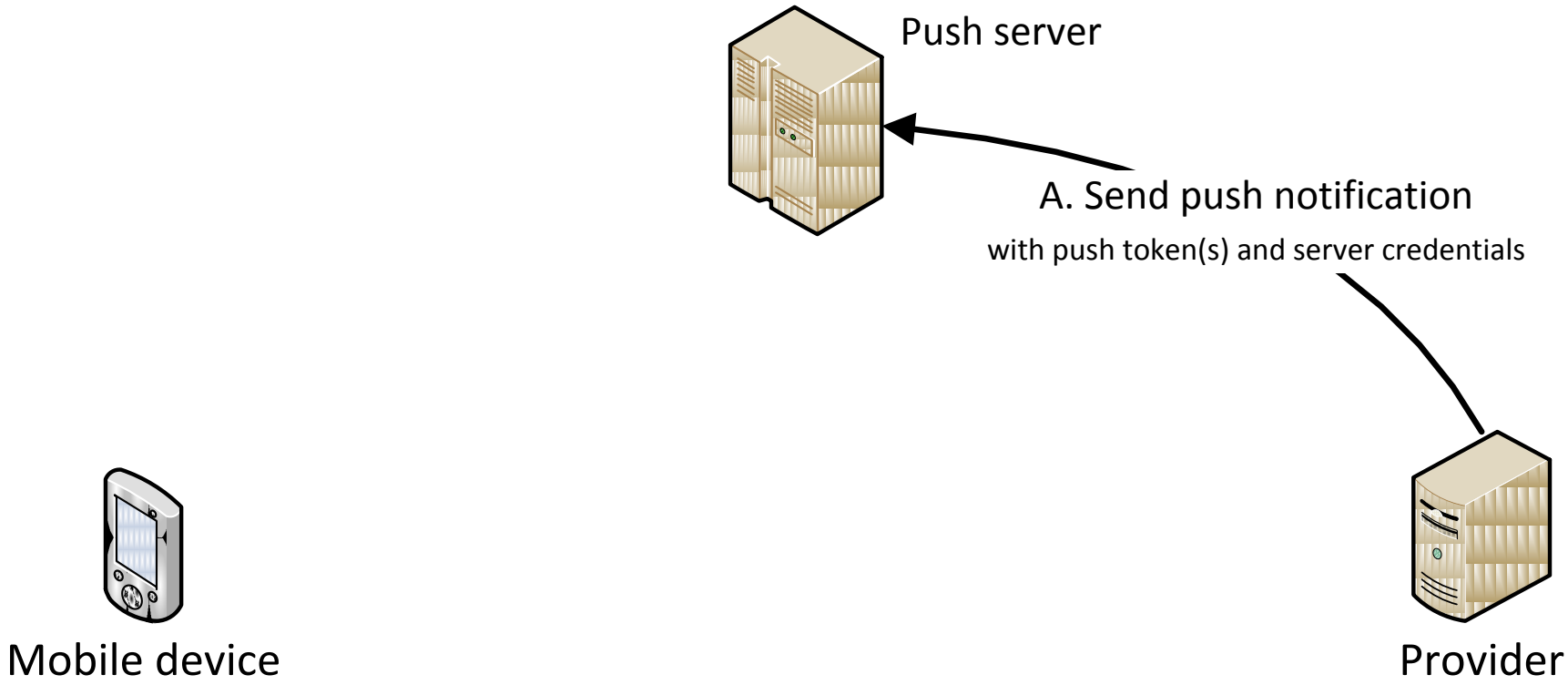

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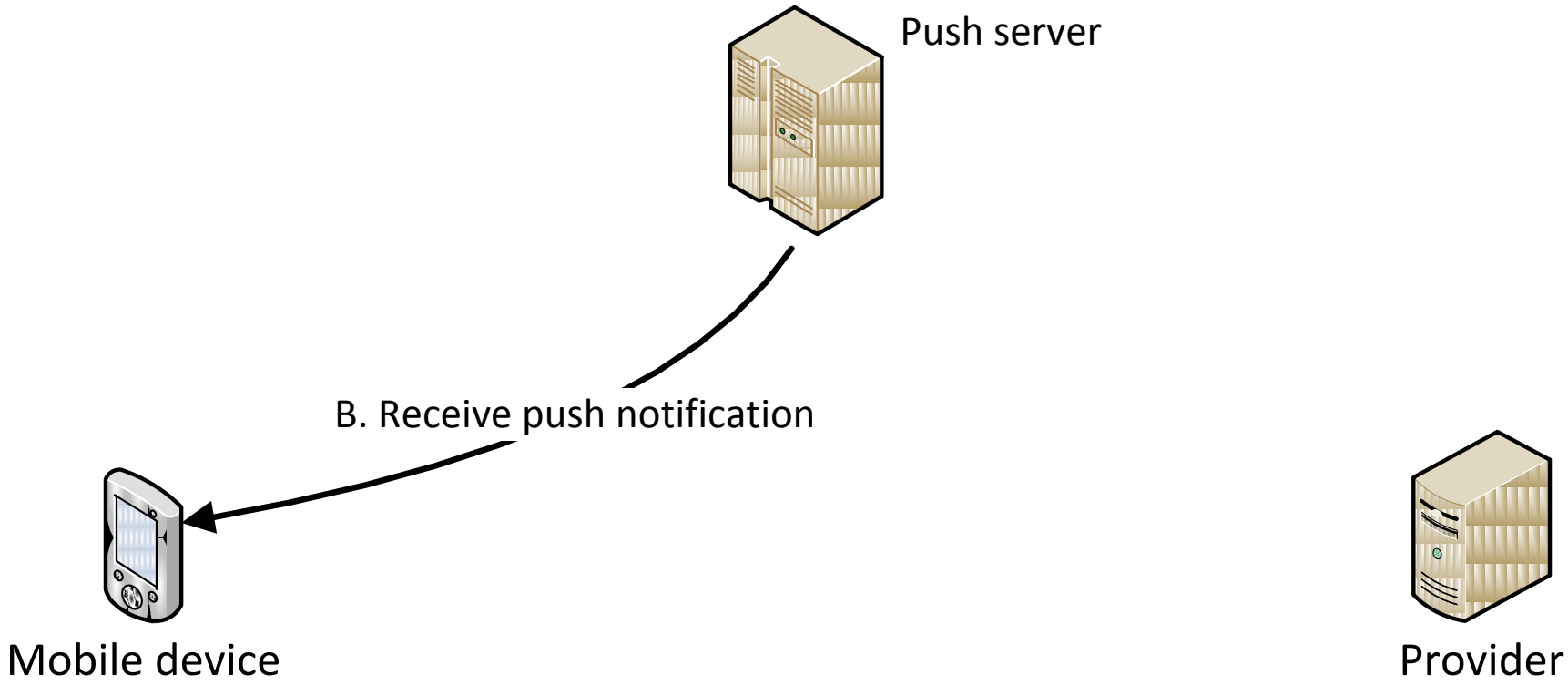

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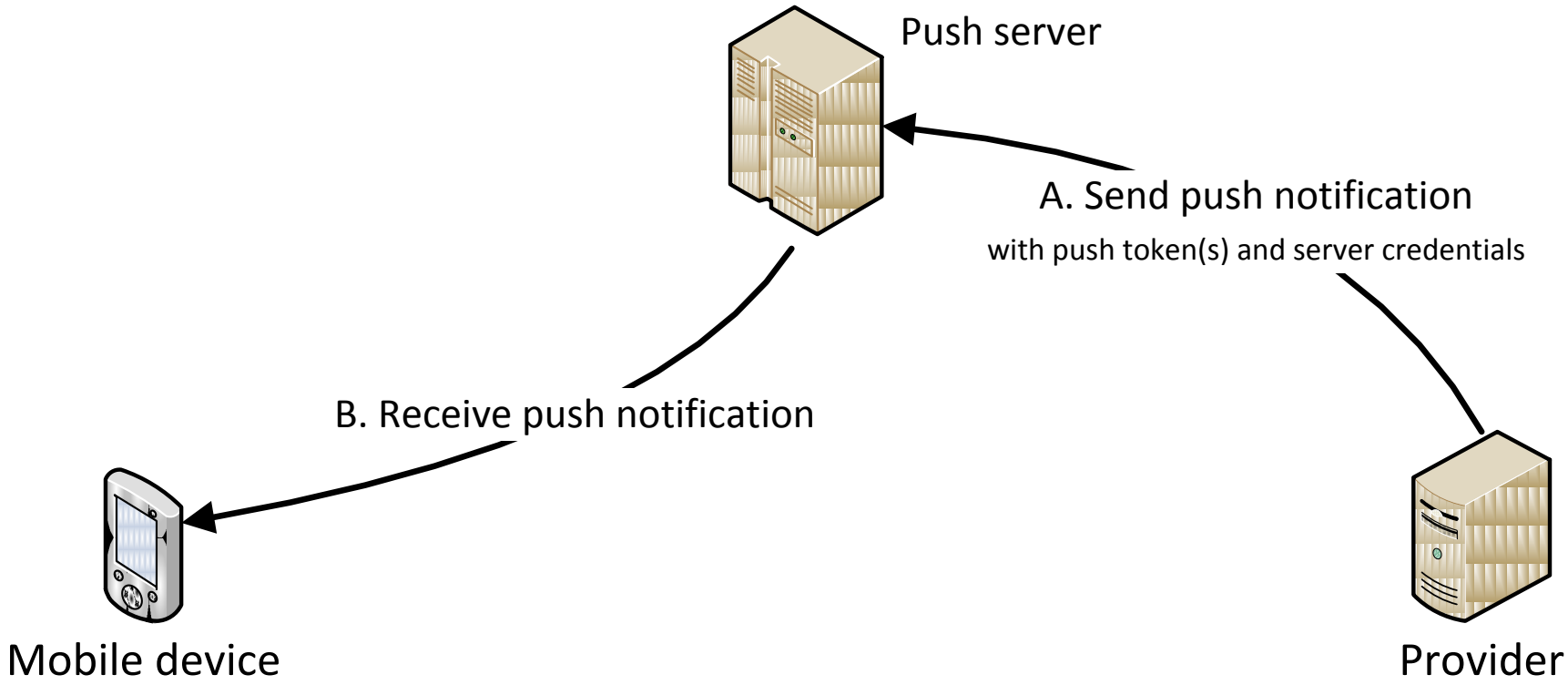

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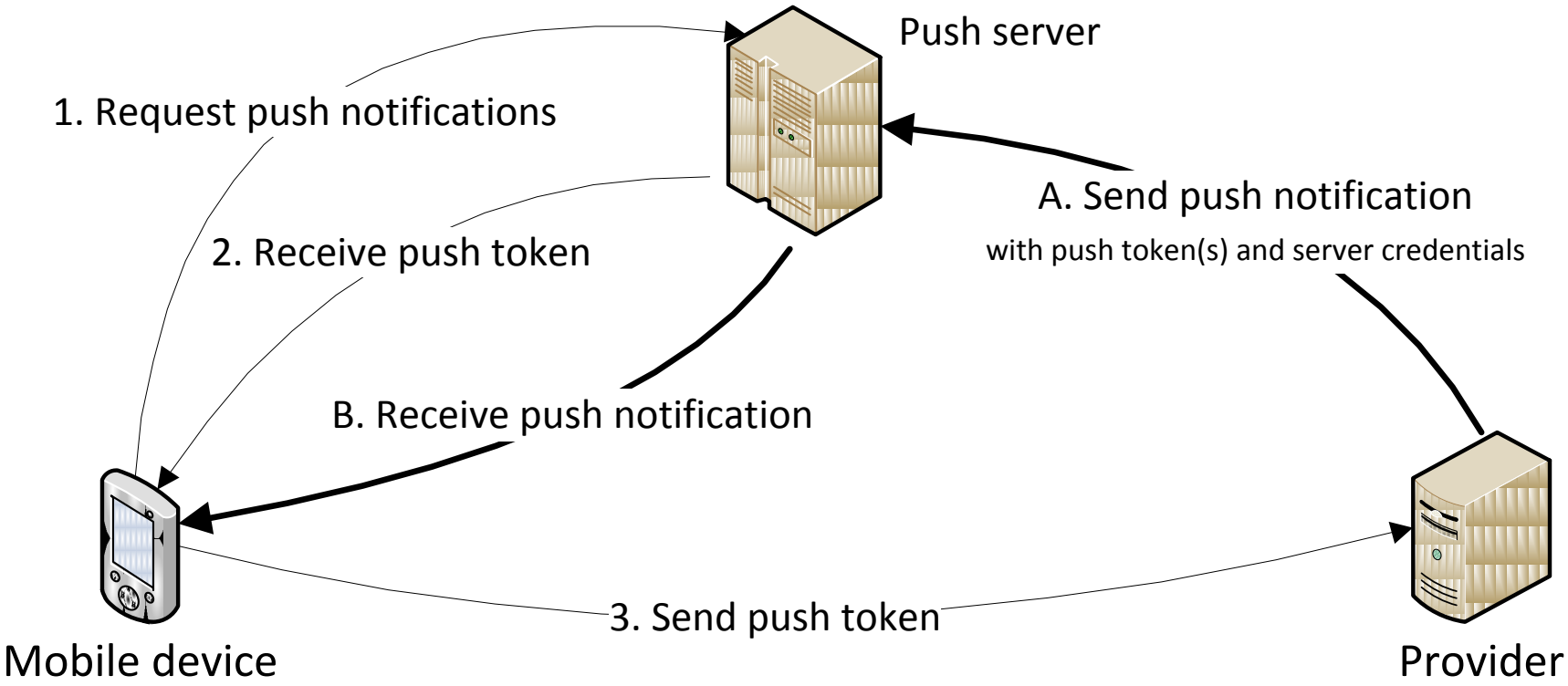

Comparison between iOS and Android

iOS (Apple Push Notifications)

- Since iOS 3.0 (2009)
  - On Mac OS X since Lion
- Payload up to 256 bytes
- Binary protocol for providers
- JSON format
- Handled by system if app is not running
  - Alert, badge or sound
- Configurable via system settings

Android (C2DM)

- Since 2.2 (2010), beta
- Payload up to 1024 bytes
- HTTP protocol for providers
- Any format
- App can be started if not already running
- Configurable via app settings (if any)

Android Cloud to Device Messaging

Implementing a client

Overview

- API consists of sending and recieving Intents
  - Pushes themselves are broadcast Intents
- Push tokens are refreshed after some time
  - App receives new one automatically
- Security is based on custom application's permission
  - Prevents receiving pushes directed to different app

Step 0: service & application setup

- Using C2DM requires registration
  - Need to provide app's package name and Google Account which will be used to send pushes
  - Requests usually take few days to process

- App manifest must include appropriate persmissions

```
<permission android:name="com.example.myapp.permission.C2D_MESSAGE"
android:protectionLevel="signature" />
<uses-permission android:name="com.example.myapp.permission.C2D_MESSAGE" />

<uses-permission android:name="com.google.android.c2dm.permission.RECEIVE" />

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

Step 1: Requesting push token

- It is actually called **registration ID**
- Straightforward: just send a simple Intent

```
Intent regItent = new Intent("com.google.android.c2dm.intent.REGISTER");
regIntent.putExtra("app", PendingIntent.getBroadcast(this, 0, new Intent(), 0));
regIntent.putExtra("sender", emailOfSender);
startService(regIntent);
```

- `emailOfSender` is the Google Account used by push provider (the server) – e.g. `c2dm@exampleapp.com`
- C2DM API will automatically (and in the background) contact the push server if needed

Step 2 & 3: Handling push tokens

- Registration ID comes as a broadcast Intent
  - Hence we need a receiver for it

```
<receiver android:name=".C2DMRegistrationReceiver"
android:permission="com.google.android.c2dm.permission.SEND">
   <intent-filter>
      <action android:name="com.google.android.c2dm.intent.REGISTRATION" />
      <category android:name="com.example.myapp" />
   </intent-filter>
</receiver>
```

- It will also receive unregistration events, should we ever request for them

```
public void onReceive(Context context, Intent intent) {
   if (intent.getStringExtra("unregistered") == null) {
      String registrationId = intent.getStringExtra("registration_id");
      sendToPushProvider(registrationId);
   }
}
```

Receiving a message

- Messages also come as broadcasted Intents

```
<receiver android:name=".C2DMMessageReceiver"
android:permission="com.google.android.c2dm.permission.SEND">
   <intent-filter>
      <action android:name="com.google.android.c2dm.intent.RECEIVE" />
      <category android:name="com.example.myapp" />
   </intent-filter>
</receiver>
```

- Payload can be fetched from Intent's extras

```
public void onReceive(Context context, Intent intent) {
   Bundle payload = intent.getExtras();
   int messageCount = Integer.parseInt(payload.getString(C2DM.MESSAGE_COUNT));
   String latestMsg = messageCount == 1 ?
                      Payload.getString(C2DM.LATEST_MESSAGE) : null;
   showNotification(messageCount, latestMsg);
}
```

Android Cloud to Device Messaging

Tips, tricks & caveats

Obtaining registration ID

- You can receive registration ID:
  - Multiple times – in response for every request
  - Again – if previous one is no longer valid
  - Without even requesting it – along with a push message
- You can also (albeit rarely) receive registration error
  - You should then try again with **exponential backoff**

- There are also other possible errors:
  - No Google Account on the phone
  - Wrong credentials on user's Google Account
  - Too many apps on the device using C2DM already

Those *in theory* should be displayed to the user (!).

Obtaining registration ID, part two

- Possible solution: `SharedPreferences` + `AlarmManager`

```
public void onReceive(Context context, Intent intent) { // C2DMRegistrationReceiver
   if (intent.getStringExtra("unregistered") == null) {
      String error = intent.getStringExtra("error");
      if (error == "SERVICE_NOT_AVAILABLE")
         scheduleC2dmRegistration();
      else { /* handle successful registration: delete C2DM_REG_TRY_INTERVAL */ }
   }
}

private void scheduleC2dmRegistration() {
   long interval = 2 * sharedPrefs.getLong(C2DM_REG_TRY_INTERVAL, 500); // ms;
   long nextTryTime = SystemClock.elapsedRealtime() + interval;

   Intent alarmIntent = new Intent(context, RegistrationRetryReceiver.class);
   PendingIntent alarm = PendingIntent.getBroadcast(context, 0, alarmIntent, 0);
   AlarmManager am = (AlarmManager)context.getSystemService(Context.ALARM_SERVICE);
   am.set(AlarmManager.ELAPSED_REALTIME, nextTryTime, alarm);
}

// RegistrationRetryReceiver simply resends com.google.android.c2dm.intent.REGISTER
```

Sending registration ID to push provider

- Since you can receive registration ID at **any time**, you cannot count on your app actually running
  - Hence you have only short time to process the broadcast
- Uploading registration ID must be done in a **service**
  - In the background via `AsyncTask` or Java threading

```
private void handleRegistrationId(String regId) {
   Intent intent = new Intent(context, PushTokenUploadService.class);
   intent.putExtra(PUSH_TOKEN_EXTRA, regId);
   startService(intent);
}
```

Bonus points for…

- Exponential backoff on push token uploading
  - Same technique – just manage the interval separately
  - Alternative: request the token more often - you'll get the same one anyway
- Retrying registration when connectivity is detected
- Unregistering when you have the opportunity
  - E.g. when user disables C2DM in your app's settings

Related topics

- Actual handling of the messages (app-specific)
  - Status bar notifications
  - „Badges” through widgets
- Implementing the server
  - Storing the push tokens
  - Authenticating to Google push server
  - Sending messages
  - Handling errors (exponential backoff)

- For more information, refer directly to the docs:

  http://code.google.com/android/c2dm/

Thank you!