IN 3510 Wireless Communication & Mobile Networks

Lab 5: Push Notifications in Flutter with Firebase Cloud Messaging (FCM)

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Learning Outcomes

By the end of this lab, you will be able to:

1. Connect a Flutter app to Firebase and enable FCM.
2. Request notification permissions and obtain the device FCM token.
3. Handle notifications in all app states: foreground, background, and terminated.
4. Display local notifications when messages arrive in the foreground.
5. Send test notifications from the Firebase Console and by topic.
6. Navigate to the notification tap & add basic analytics.

Why Push Notifications?

- Engage users when they're not actively using the app
- Drive user retention and re-engagement
- Deliver time-sensitive information
- Personalized user experience
- Important marketing and communication channel

Push Notifications in the real world?

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Types of Notifications

1. Foreground Notifications
   - App is open and visible
   - User actively using the app
   - Can show in-app alerts
2. Background Notifications
   - App minimized but running
   - Shows in the system tray

    - The user can tap to open the app
3. Terminated Notifications
    - App completely closed
    - The system handles delivery
    - Wake the app to handle notifications

Key Components of a Notification

- FCM Token: Unique identifier for each device
- Notification Channel: Groups notifications by importance
- Payload: Data sent in notification
- Handlers: Code that processes notifications

Implementation Steps Summary

1. Firebase setup
    - Add Firebase to the project
    - Configure platforms
    - Get configuration files
2. App Configuration.
    - Request permissions
    - Initialize Firebase
    - Set up handlers
3. Handle Different States.
    - Foreground handler
    - Background handler
    - Tap actions

Implementation Steps Descriptive

1) Create a Firebase Project & Android App

1. Go to **Firebase Console** → Add project → enable Google Analytics (optional).
2. Add Firebase to your Flutter app
    - From any directory, run this command:

```
dart pub global activate flutterfire_cli
```

    - Then, at the root of your Flutter project directory, run this command:

```
flutterfire configure --project=mobile-wireless-1 --platforms=android
```

3. In Firebase → Run → **Cloud Messaging** → make sure it's enabled.

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2) Add Packages (pubspec.yaml)

```
dependencies:
  flutter:
    sdk: flutter
  firebase_core: ^3.12.0
  firebase_messaging: ^15.1.2
  awesome_notifications_fcm: ^0.10.1
```

Run:

```
flutter pub get
```

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3) Android Notification Channel & Manifest Tweaks

Android 8.0 and later require a channel for high-priority alerts.

```
<meta-data
android:name="com.google.firebase.messaging.default_notification_channel_id"
      android:value="high_importance_channel" />
<meta-data
      android:name="com.google.firebase.messaging.default_notification_icon"
      android:resource="@mipmap/ic_launcher" />
```

Permissions (Android 13+ needs runtime permission):

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

> **Note:** We'll request this permission in Dart at runtime.

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4) Dart Code

```
import 'package:flutter/material.dart';
import 'package:firebase_core/firebase_core.dart';
import 'package:firebase_messaging/firebase_messaging.dart';
import 'package:awesome_notifications/awesome_notifications.dart';
import 'firebase_options.dart';

/// Background handler must be a top-level function
@pragma('vm:entry-point')
Future<void> firebaseMessagingBackgroundHandler(RemoteMessage message) async
{
  await Firebase.initializeApp(options:
DefaultFirebaseOptions.currentPlatform);
}

void main() async {
  WidgetsFlutterBinding.ensureInitialized();
  await Firebase.initializeApp(options:
DefaultFirebaseOptions.currentPlatform);

  // Register background handler BEFORE runApp
  FirebaseMessaging.onBackgroundMessage(firebaseMessagingBackgroundHandler);

  // Initialize Awesome Notifications (local)
  await AwesomeNotifications().initialize(
      null, // use default app icon
      [
      NotificationChannel(
        channelKey: 'high_importance_channel',
      channelName: 'High Importance Notifications',
      channelDescription: 'Channel for urgent notifications',
      importance: NotificationImportance.Max,
      defaultRingtoneType: DefaultRingtoneType.Notification,
      ledColor: Colors.white,
      ),
      ],
      debug: true,
  );

  runApp(const MyApp());
}

class MyApp extends StatefulWidget {
```

```dart
  const MyApp({super.key});
  static final GlobalKey<NavigatorState> navigatorKey =
GlobalKey<NavigatorState>();
  @override
  State<MyApp> createState() => _MyAppState();
}

class _MyAppState extends State<MyApp> {
  String? _token;
  String _lastMessage = 'No messages yet';

  @override
  void initState() {
      super.initState();
      _initMessaging();
      // Awesome v0.10.x: use setListeners instead of actionStream
      AwesomeNotifications().setListeners(
      onActionReceivedMethod: (receivedAction) async {
      final payload = receivedAction.payload ?? {};
      final text = payload['message'] ?? 'No payload';
      if (mounted) {
            Navigator.of(context).push(
            MaterialPageRoute(
            builder: (_) => DetailsPage(text: text),
            ),
            );
      }
      },
      );
  }

  Future<void> _initMessaging() async {
      final messaging = FirebaseMessaging.instance;

      // Android 13+/iOS: request permission
      final settings = await messaging.requestPermission(alert: true, badge:
true, sound: true);
      debugPrint('Permission: \${settings.authorizationStatus}');

      // Get token
      _token = await messaging.getToken();
      debugPrint('FCM Token: \$_token');
      setState(() {});
      // Topic subscription (optional)
      await messaging.subscribeToTopic('in3510');

      // Foreground messages: show local notification
      FirebaseMessaging.onMessage.listen((RemoteMessage message) {
      setState(() { _lastMessage = message.data.toString(); });
      final notification = message.notification;
      final title = notification?.title ?? message.data['title'] ?? 'IN3510
Message';
      final body = notification?.body ?? message.data['body'] ?? 'Open to
view details';
      AwesomeNotifications().createNotification(
      content: NotificationContent(
            id: DateTime.now().millisecondsSinceEpoch.remainder(100000),
            channelKey: 'high_importance_channel',
            title: title,
            body: body,
            payload: {
            'route': '/details',
            'message': message.data.toString(),
            },
      ),
      );
      });

      // App opened from background by tapping a system notification
      FirebaseMessaging.onMessageOpenedApp.listen((RemoteMessage message) {
      _handleNotificationTap(message.data);
      });

      // App opened from TERMINATED state via notification
      final initialMessage = await messaging.getInitialMessage();
      if (initialMessage != null) {
      _handleNotificationTap(initialMessage.data);
      }
  }

  void _handleNotificationTap(Map<String, dynamic> data) {
      Navigator.of(context).push(
      MaterialPageRoute(builder: (_) => DetailsPage(text: data.toString())),
      );
  }
  @override
  Widget build(BuildContext context) {
      return MaterialApp(
      title: 'IN3510 FCM Lab',
      navigatorKey: MyApp.navigatorKey,
      home: Scaffold(
      appBar: AppBar(title: const Text('IN3510 • FCM Lab')),
      body: Padding(
            padding: const EdgeInsets.all(16.0),
            child: Column(
            crossAxisAlignment: CrossAxisAlignment.start,
            children: [
            const Text('1) Ensure Firebase is configured.'),
            const SizedBox(height: 8),
            const Text('2) FCM Token:'),
            SelectableText(_token ?? 'Fetching…'),
            const Divider(),
            const Text('Last foreground message data:'),
            Text(_lastMessage),
            const Spacer(),
            ElevatedButton(
                  onPressed: () async {
                  AwesomeNotifications().createNotification(
                  content: NotificationContent(
                        id: 1001,
                        channelKey: 'high_importance_channel',
                        title: 'Local test',
                        body: 'This is a local notification',
                        payload: {'route': '/details', 'message': 'Local test
payload'},
                  ),
                  );
                  },
                  child: const Text('Show Local Test Notification'),
            ),
            ],
            ),
      ),
      ),
      );
  }
}
```

```
class DetailsPage extends StatelessWidget {
  final String text;
  const DetailsPage({super.key, required this.text});
  @override
  Widget build(BuildContext context) {
      return Scaffold(
      appBar: AppBar(title: const Text('Notification Details')),
      body: Padding(
      padding: const EdgeInsets.all(16.0),
      child: Text(text),
      ),
      );
  }
}
```

Github Link -
https://github.com/BhanukaC/IN-3510-Wireless-Communication-Mobile-Networks-Lab-5

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5) Sending Test Messages

5.1 Firebase Console (No code)

- Go to Firebase Console → Messaging → Campaign
- New notification → Target a single device: paste the app's FCM token from the UI.
- Enter Title/Body → Send.

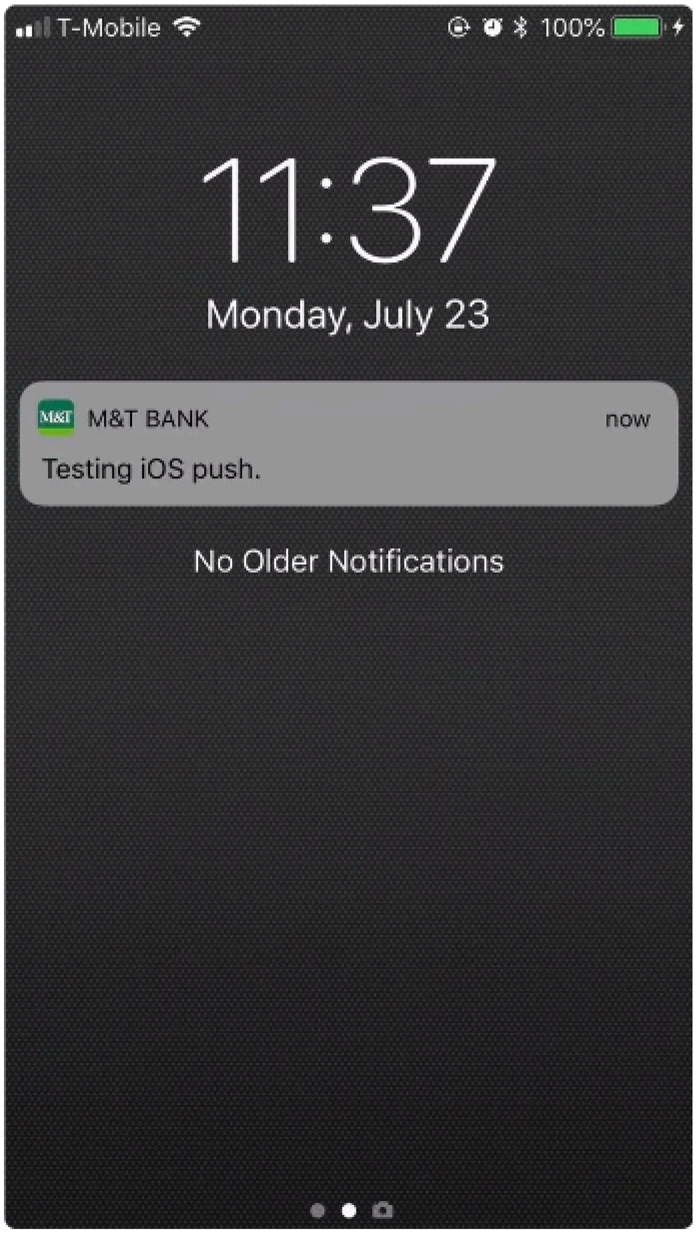
5.2 Topic Messages

- In the console, choose Topic and enter in3510 (we subscribed in code)
- Send to all devices subscribed to in3510.

Best Practices

- Clear and concise messages
- Appropriate timing
- Respect user preferences
- Handle all app states
- Test thoroughly
- Monitor delivery rates

Questions



Testing iOS push.

Readings

[Notifications | FlutterFire]