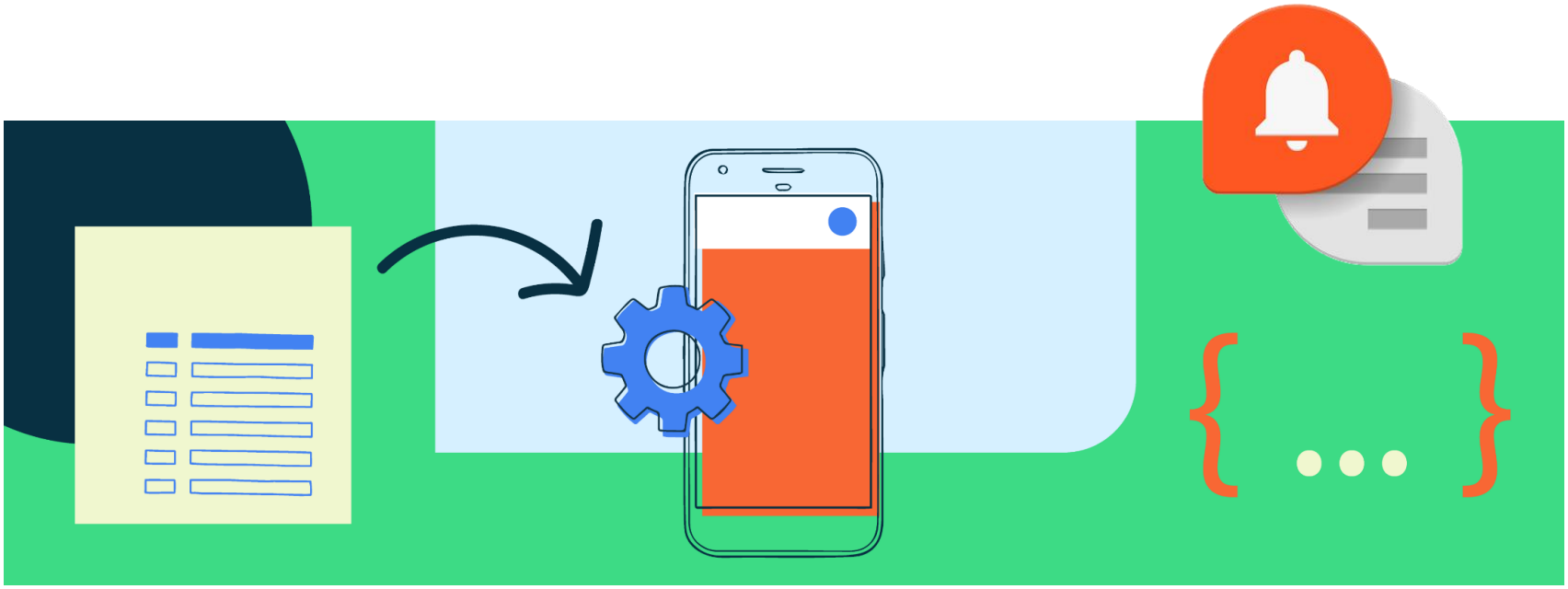
Work Manager & Notification Manager



WorkManager

- WorkManager is an Android library to **schedule** & **execute** persistent, asynchronous tasks that must be run reliably
  - Tasks that remains scheduled even after app restarts and system reboots
  - Tasks be immediate or **deferrable** (i.e., ok to run at later time)
  - Intended for tasks that require a **guarantee** that the system will run them even if the app is inactive
- Can specify **constraints** that must be satisfied before the work is executed (e.g., only upload images to Firebase Storage when Wi-Fi connection is available)
- Can configure **retries** if the job fails

Implementing Work Manager

- Add Dependency

```
val workVersion = "2.8.1"
implementation("androidx.work:work-runtime-ktx:$workVersion")
```

- Extend **`Worker`** class
- Override **`doWork`** method
  - Return result: SUCCESS, FAILURE, RETRY
- Schedule Work: immediate execution, execute after initial delay, execute periodically

Define work to do using Worker

- Define a unit of work to perform in the background using class that extends **Worker** class and implements **doWork** method

```
class UploadWorker(context: Context, params:WorkerParameters) : Worker(context, params) {
    override fun doWork(): Result {
        return try {
            val count = inputData.getInt(Constants.COUNT_VALUE , 0)
            for (i in 0 until count) {
                Log.i("UploadWorker", "Uploading $i")
            }
            val dateFormat = SimpleDateFormat("dd/M/yyyy hh:mm:ss aa")
            val currentDate = dateFormat.format(Date())

            val outputData = workDataOf(Constants.CURRENT_DATE to currentDate)
            Result.success(outputData)
        } catch (e: Exception) {
            Result.failure()
        }
    }
}
```

One Time Work Request

- Create a **`OneTimeWorkRequest,`** pass parameters. Then **`enqueue`** the request
- Can start immediately or after an **`Initial Delay`**
- **`.addTag`** is used to assign a Human Readable identifier or create logical groups of work requests

```
val inputData = workDataOf(Constants.COUNT_VALUE to 125)
val downloadRequest = OneTimeWorkRequestBuilder<DownloadWorker>()
                        .setInitialDelay(10, TimeUnit.Minutes)
                        .setInputData(inputData)
                        .addTag(Constants.TAG_DOWNLOAD)
                        .build()

WorkManager.getInstance(applicationContext)
           .enqueue(downloadRequest)
```

Schedule Period Work Request

- Use **`PeriodicWorkRequest`** to schedule a work to repeat periodically

```
// Create a periodic work request with 15 mins as repeat interval
val repeatInterval = 15

val periodicWorkRequest = PeriodicWorkRequestBuilder<DownloadWorker>
                                (repeatInterval, TimeUnit.MINUTES).build()

WorkManager.getInstance(applicationContext).enqueue(periodicWorkRequest)
```

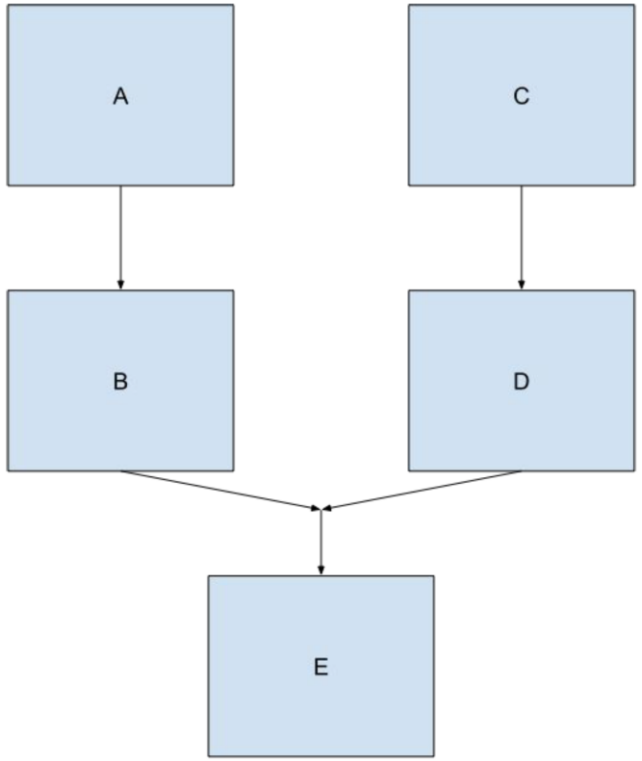
Define Constraints

- You can define constraints that must be met before the work starts:
  - Network connectivity
  - Battery
  - Storage
  - Device State: device charging, device idle

```
val constraints = Constraints.Builder()
            .setRequiredNetworkType(NetworkType.CONNECTED)
            .setRequiresBatteryNotLow(true)
            .setRequiresCharging(true)
            .setRequiresDeviceIdle(false)
            .setRequiresStorageNotLow(false)
            .build()
val uploadRequest = OneTimeWorkRequestBuilder<UploadWorker>()
                                    .setConstraints(constraints)
                                    .build()
```

Work Chaining

- Orchestration of multiple jobs. E.g.,
  - B runs after A
  - D runs after C
  - E runs after B and D are completed




```
val parallelWorks = listOf(downloadRequest, filterRequest)
workManager.beginWith(parallelWorks)
           .then(compressRequest)
           .then(uploadRequest)
           .enqueue()
```

Configure retries

- If you require that WorkManager retry failed work, you can return **Result.retry()** from your worker. Your work is then rescheduled according to a **backoff delay** and **backoff policy**.

```
val uploadRequest = OneTimeWorkRequestBuilder<UploadWorker>()
                    .setBackoffCriteria(
                        BackoffPolicy.LINEAR,
                        10,
                        TimeUnit.MINUTES)
                    .build()
```

Unique Work

- Three possible policies for **OneTimeWorker**: KEEP, REPLACE, APPEND
- Two possible policies for **PeriodicWorker**: KEEP, REPLACE

```
class MyApp: Application() {
override fun onCreate() {
    super.onCreate()
    val backupWorkRequest =
       PeriodicWorkRequestBuilder<BackupWorker>(8, TimeUnit.HOURS).build()
       WorkManager.getInstance(applicationContext).enqueueUniquePeriodicWork(
              "BackupWork",
              ExistingPeriodicWorkPolicy.REPLACE,
              backupWorkRequest)
    }
}
```

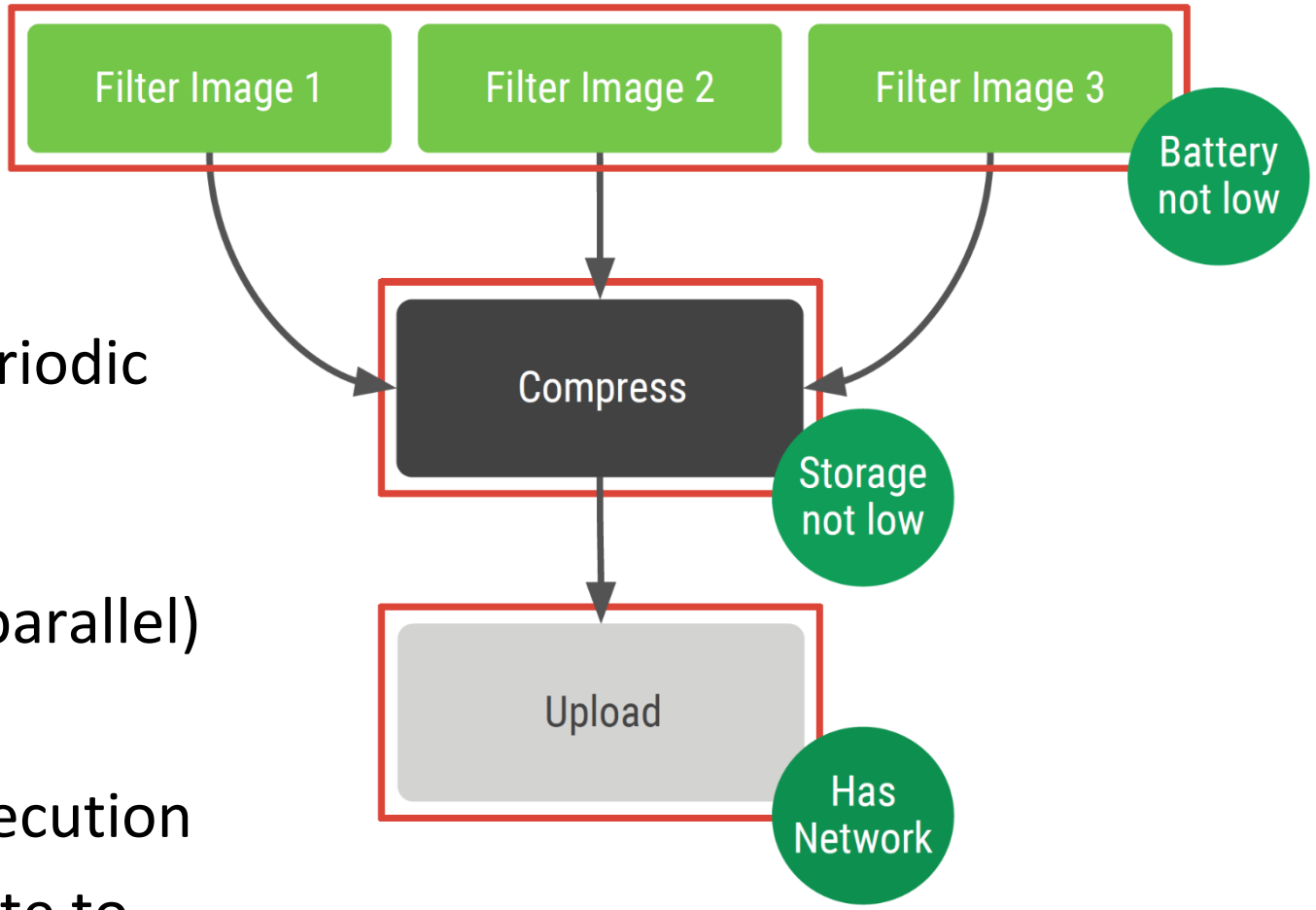
Coroutines + WorkManager

- Use **`CoroutineWorker`** to call coroutines in **doWork**
- You can specify a Dispatcher to use otherwise **`Dispatchers.Default`** is used by default

```
class AsyncWorker(context : Context, params: WorkerParameters)
        : CoroutineWorker(context, params) {
    override suspend fun doWork(): Result = withContext(Dispatchers.IO) {
        try {
            // Do async tasks
            Result.success()
        } catch (error: Throwable) {
            Result.failure()
        }
    }
}
```

Summary of features

- One-off and periodic work
- Work Chaining (sequential or parallel)
- Constraints
- Guaranteed execution
- Query work state to display on UI



Monitor work execution

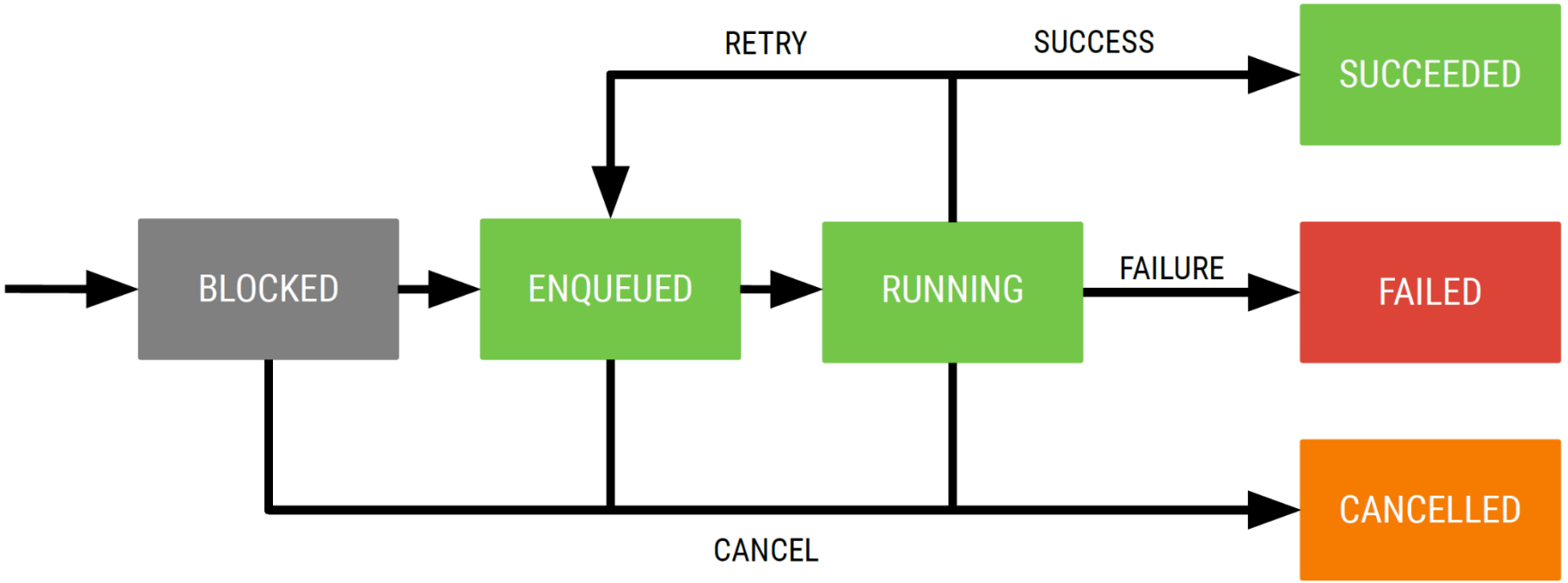
- Query status by ID, Tag or Unique Name

```
workManager.getWorkInfoById(requestId)
workManager.getWorkInfosByTag("Sync")
```

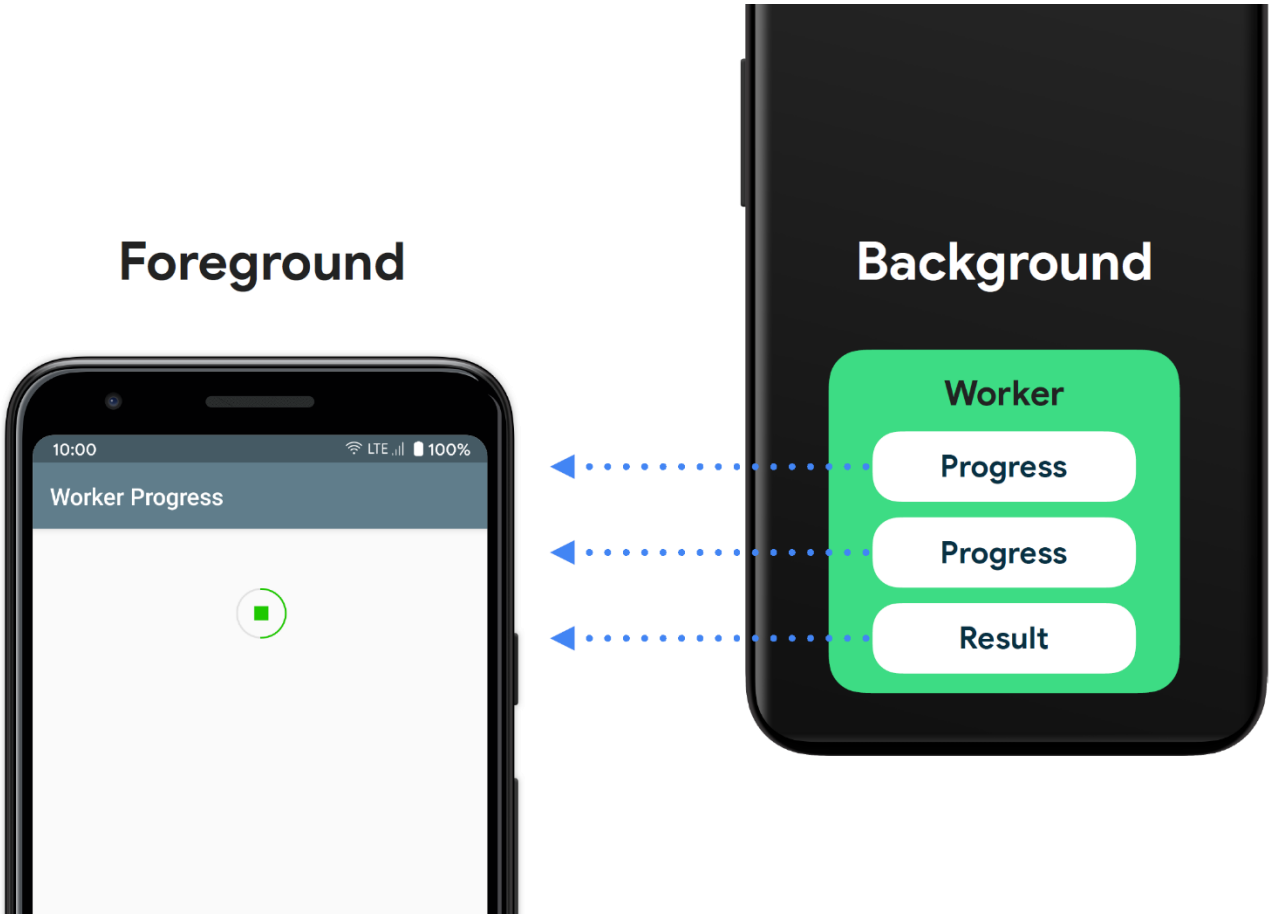
- Monitor status → Flow providing job status
  - Use **`.getWorkInfoByIdFlow`** to observe the work progress

```
private val _workInfoFlow: MutableStateFlow<WorkInfo?> = MutableStateFlow(null)
val workInfoFlow: StateFlow<WorkInfo?> = _workInfoFlow.asStateFlow()
…
workManager.getWorkInfoByIdFlow(request.id).collect { workInfo ->
    _workInfoFlow.emit(workInfo)
}
```

Life of OneTime Work



Worker Progress



Reporting Worker Progress

```
class ProgressWorker(context: Context, parameters: WorkerParameters) :
        CoroutineWorker(context, parameters) {
    override suspend fun doWork(): Result {
        setProgress(workDataOf(Constants.PROGRESS to 25))
        ...
        setProgress(workDataOf(Constants.PROGRESS to 50))
        ...
        return Result.success()
    }
}
```

Observing Worker Progress

```
val request = OneTimeWorkRequestBuilder<ProgressWorker>().build()
workManager.
        .getWorkInfoByIdFlow(request.id)
        .collect(this, Observer { workInfo: WorkInfo? ->
            if (workInfo != null) {
                val progress = workInfo.progress
                val value = progress.getInt(Constants.PROGRESS, 0)
                    // Do something with progress information
            }
        })
```

Cancel Work

- Can cancel work using the work request id or the associated tag

```
val saveImageWorkRequest = OneTimeWorkRequestBuilder<SaveImageWorker>()
        .addTag(TAG_SAVE_IMAGE)
        .build()

WorkManager.getInstance(applicationContext).cancelWorkById(saveImageWorkRequest.id)
WorkManager.getInstance(applicationContext).cancelAllWorkByTag(TAG_SAVE_IMAGE)

// Or cancel all work
WorkManager.getInstance(applicationContext).cancelAllWork()
```

Notification Manager

Back

Notification

- A notification is a message that Android displays outside your app's UI to provide the user with reminders, communication from other people, or other timely information from your app
  - Users can tap the notification to open your app or take an action directly from the notification
- A notification first appears as an icon in the status bar. Users can swipe down on the status bar to open the notification drawer, where they can view more details and take actions with the notification
  - Notifications may also appear as badge on the app's icon

Local Notification - Programming Steps

1. Create a notification channel to create and manage notifications

```
val notificationChannel=NotificationChannel("water_notification", "Water",
        NotificationManager.IMPORTANCE_HIGH)
val notificationManager=getSystemService(NOTIFICATION_SERVICE) as NotificationManager
notificationManager.createNotificationChannel(notificationChannel)
```

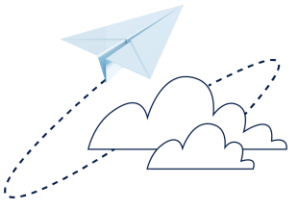
2. Create a Notification using `NotificationCompat.Builder` Set its content, title, icon, and other necessary properties.

3. Obtain Notification Manager instance using `getSystemService(Context.NOTIFICATION_SERVICE)`

4. Issue the `notify()` method of the NotificationManager to display the notification

Notification Action

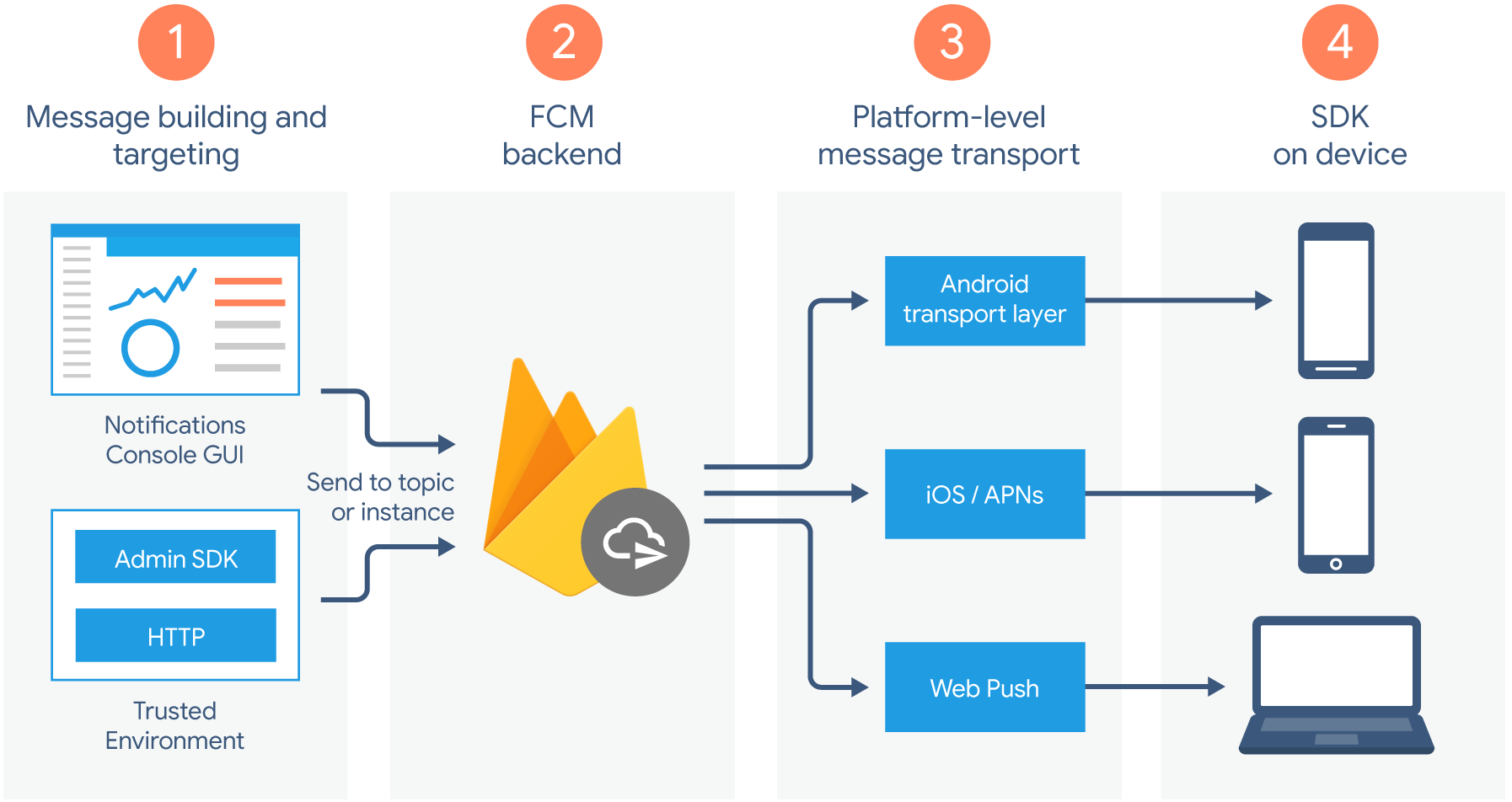
- Users can tap the notification to open your app or take an action directly from the notification
- Set up Intents and PendingIntent: to define actions to be taken when the notification is clicked
  - E.g., launching an activity or executing a specific action within your app



Push Notifications

- Firebase Cloud Messaging (FCM) is a cross-platform messaging solution that lets you reliably send messages at no cost
  - Using FCM, you can notify a client app that new email or other data is available to sync
  - You can send notification messages to drive user re-engagement and retention (e.g., 20% off Qatar Airways ticket during Qatar National Day)
- Messages can be sent to client app in any of 3 ways: to single devices, to groups of devices, or to devices subscribed to topics

FCM Architecture



Summary

- Schedule and execute persistent, asynchronous tasks that must be run reliably
  - Guarantees execution across system reboots
- Could be one-time or periodic work
- Can specify **constraints** that must be satisfied before the work is executed
- Cancellable work
- Can query the work state and progress
- **Notification Manager** can be used to send notifications

Resources

- Getting started with WorkManager
  - https://developer.android.com/topic/libraries/architecture/workmanager/basics
  - https://developer.android.com/topic/libraries/architecture/workmanager
- WorkManager codelab
  - https://developer.android.com/codelabs/android-workmanager