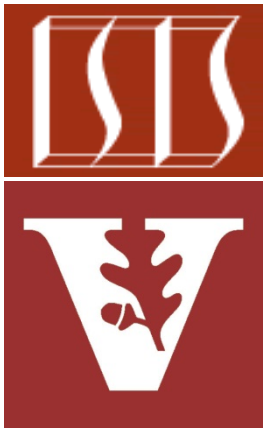
Android Concurrency: Overview of Android Handler



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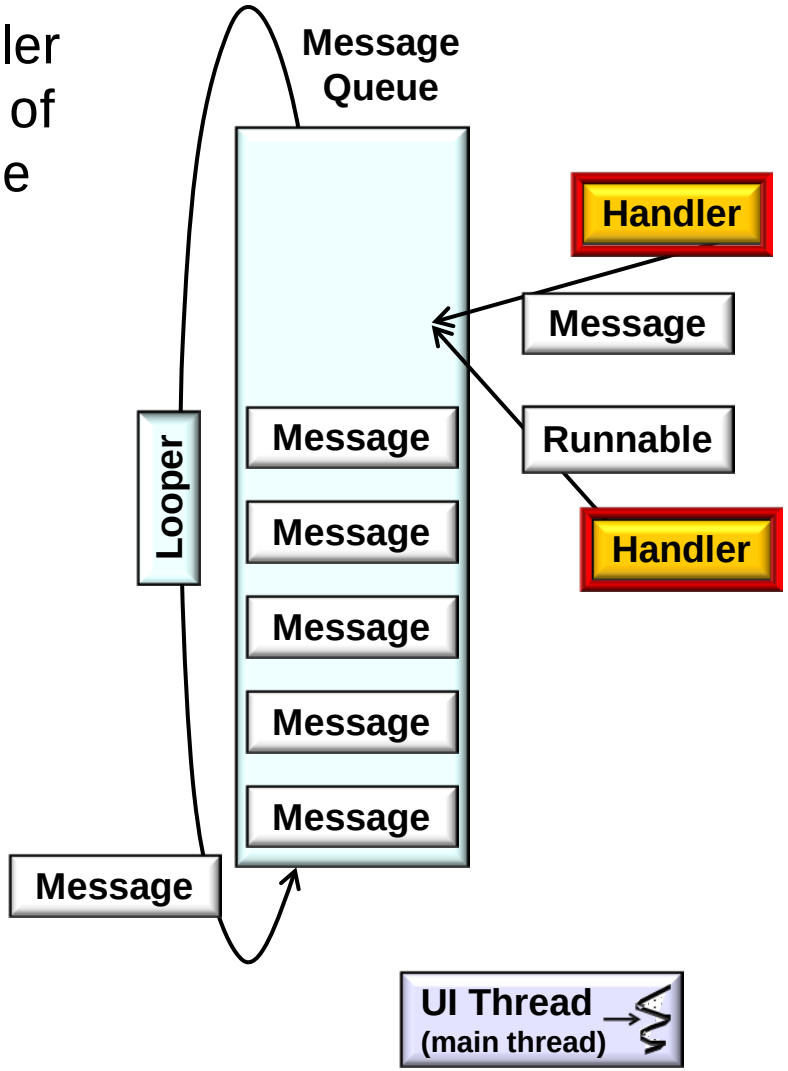
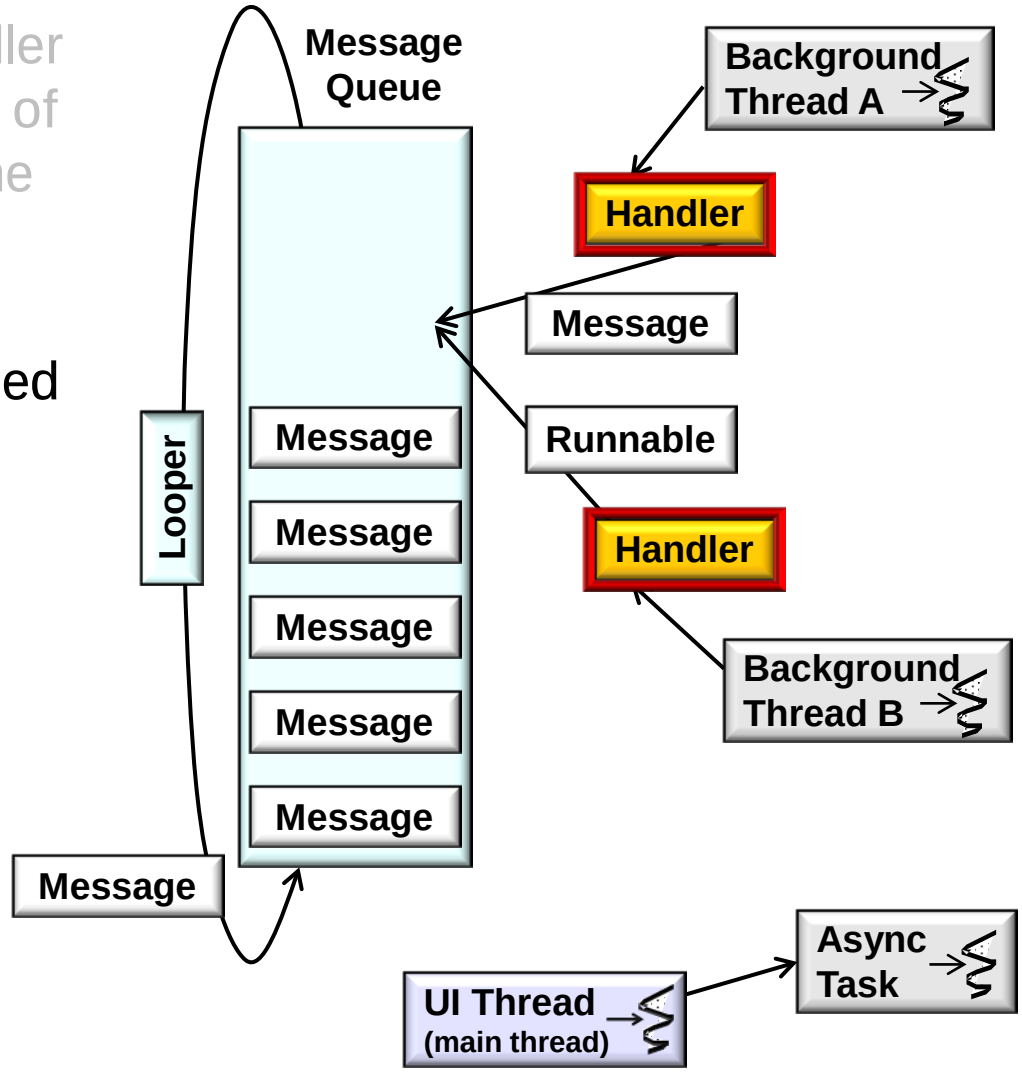
Learning Objectives in this Part of the Module

- Understand how an Android Handler enables the sending & processing of Message & Runnable objects in the MessageQueue associated with a Thread's Looper



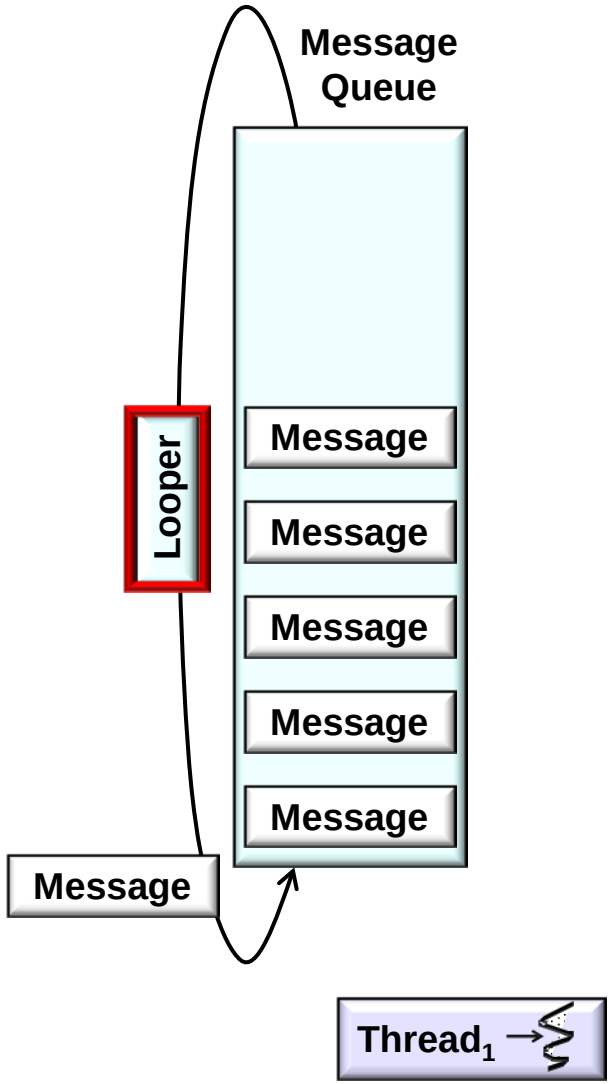
Learning Objectives in this Part of the Module

- Understand how an Android Handler enables the sending & processing of Message & Runnable objects in the MessageQueue associated with a Thread's Looper
- Recognize how Handlers are applied in Android applications & concurrency frameworks



The Handler Class

- A Looper has a MessageQueue



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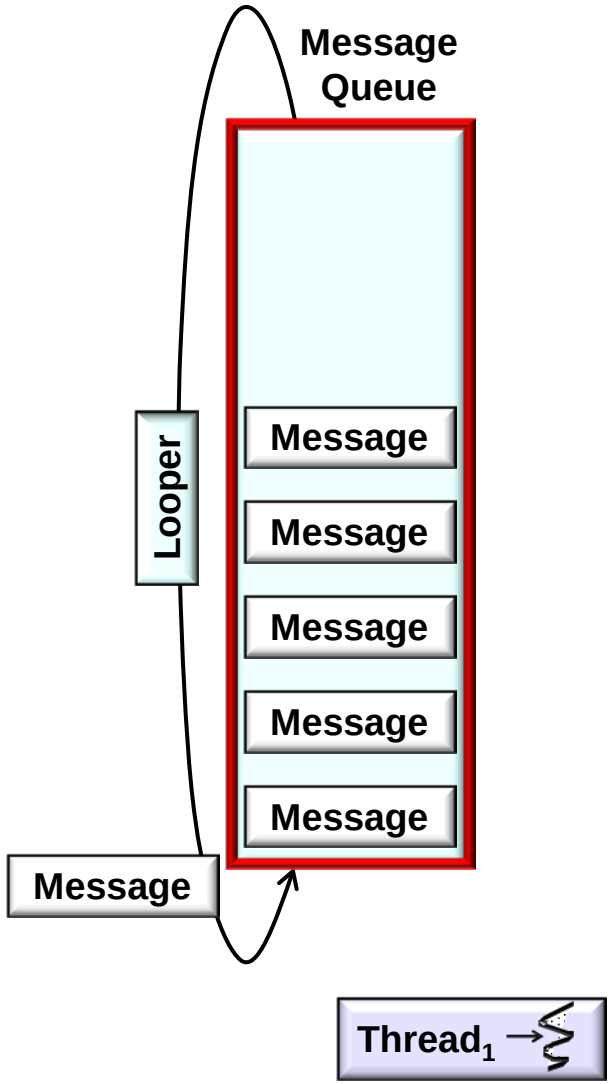

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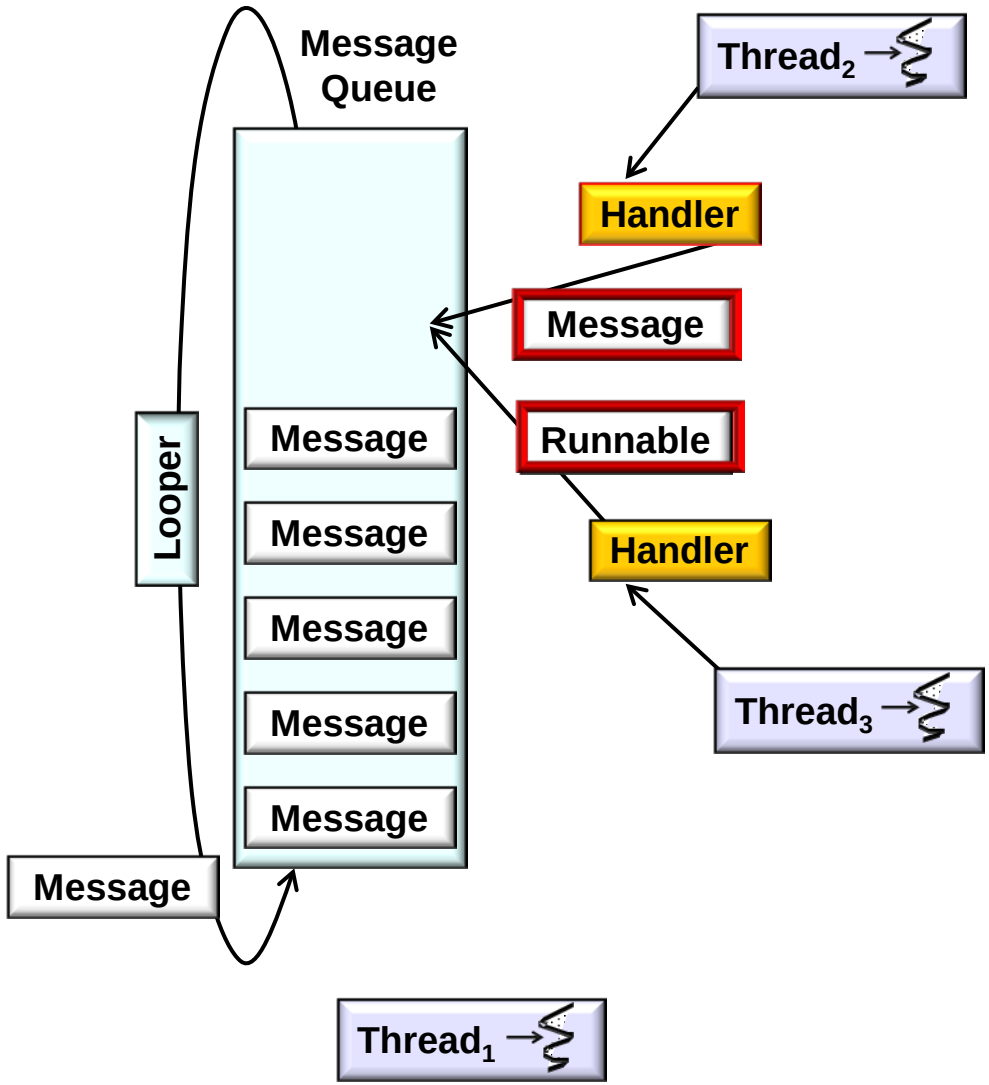

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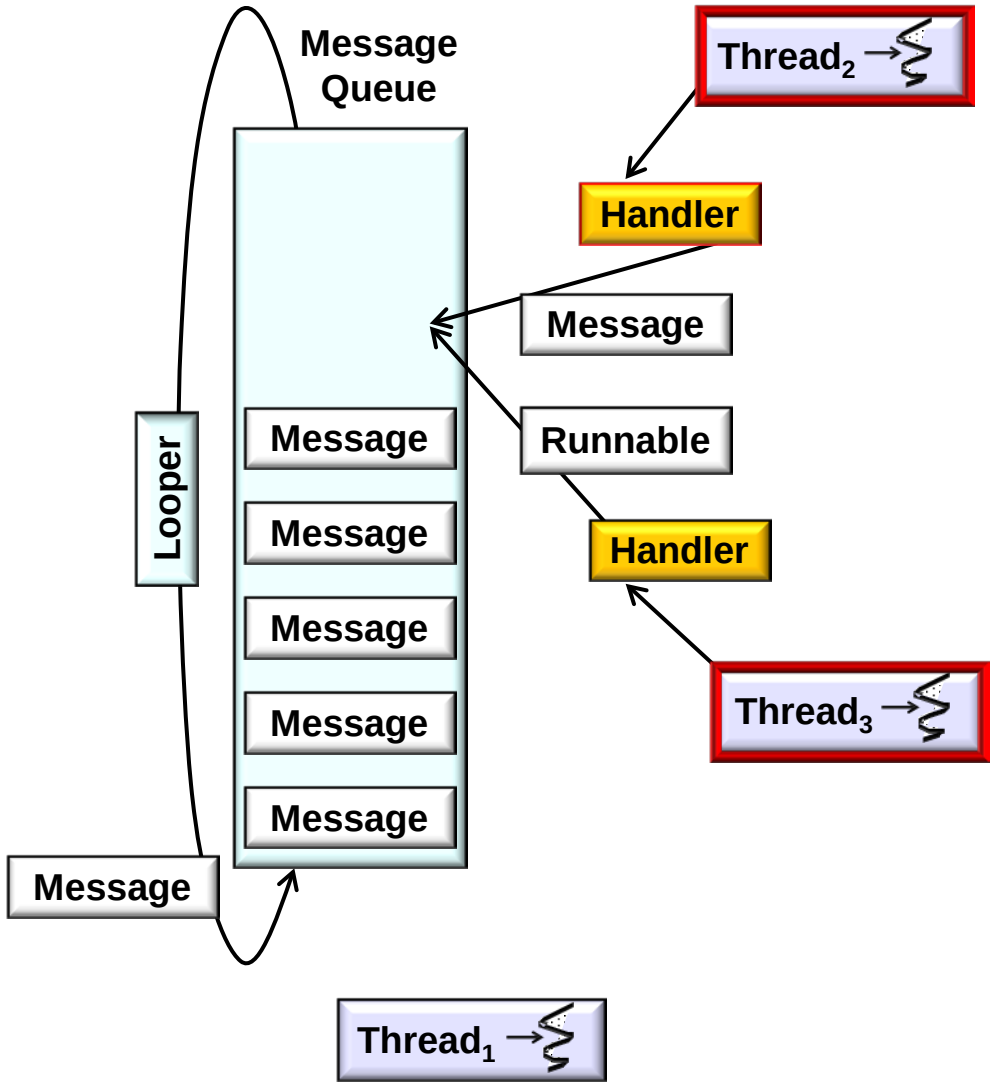
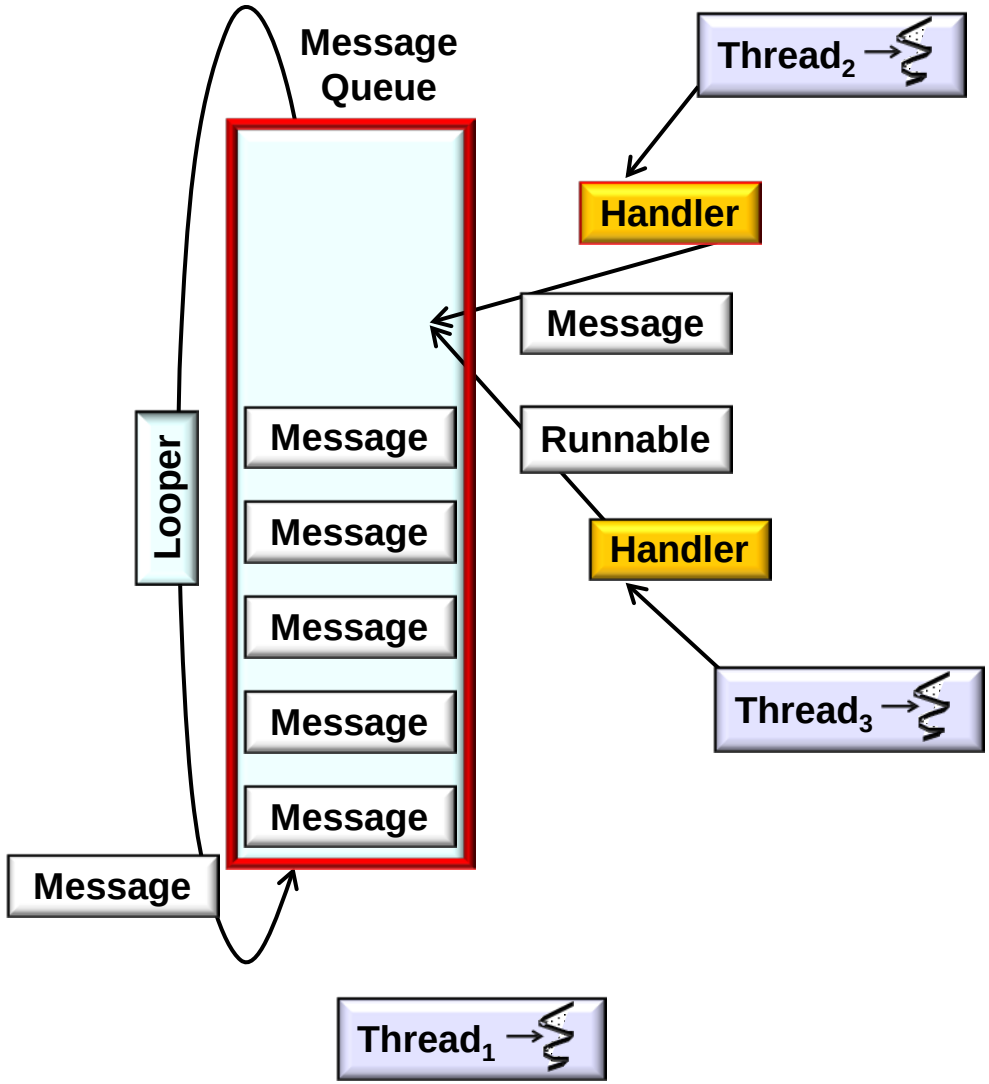


See previous part on “Android Looper”

The Handler Class

- A Looper has a MessageQueue
  - The actual management of the MessageQueue is done by instances of Handlers



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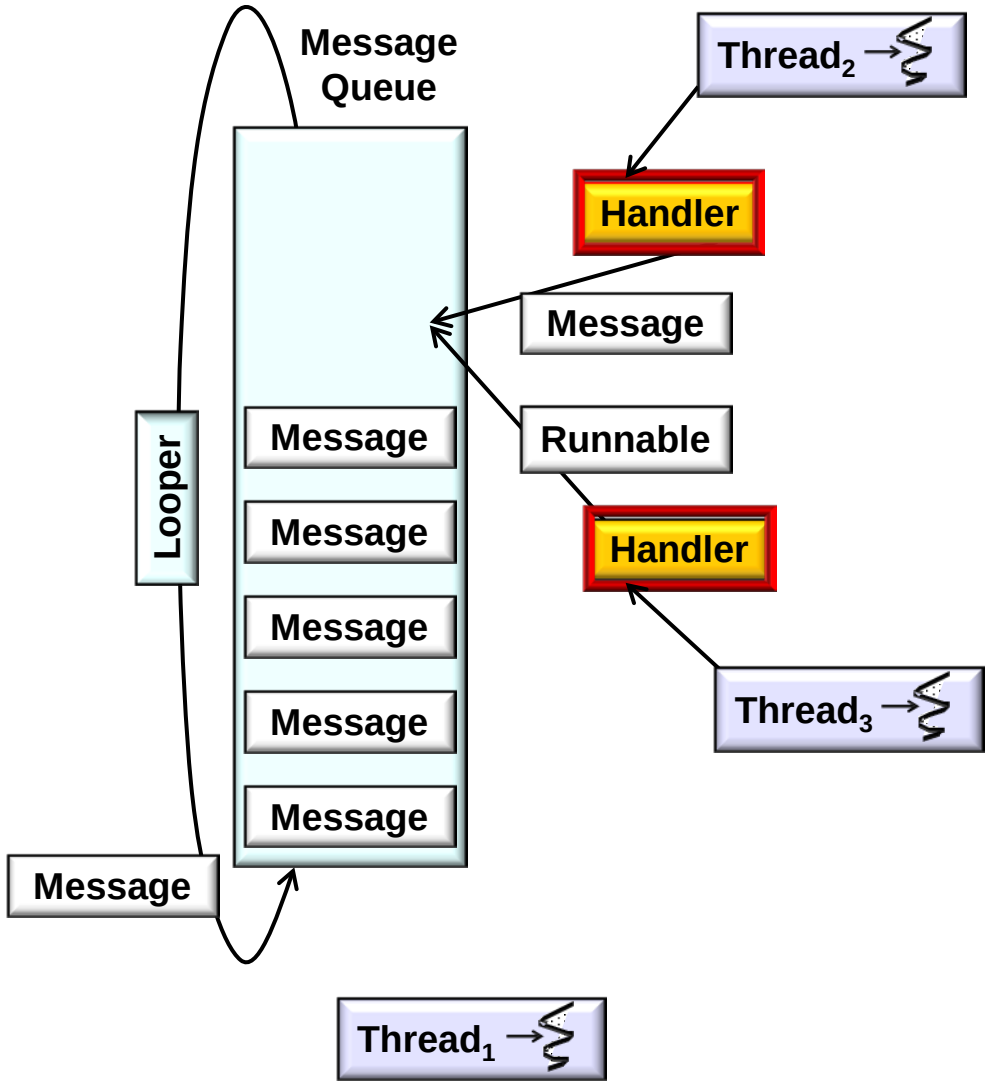

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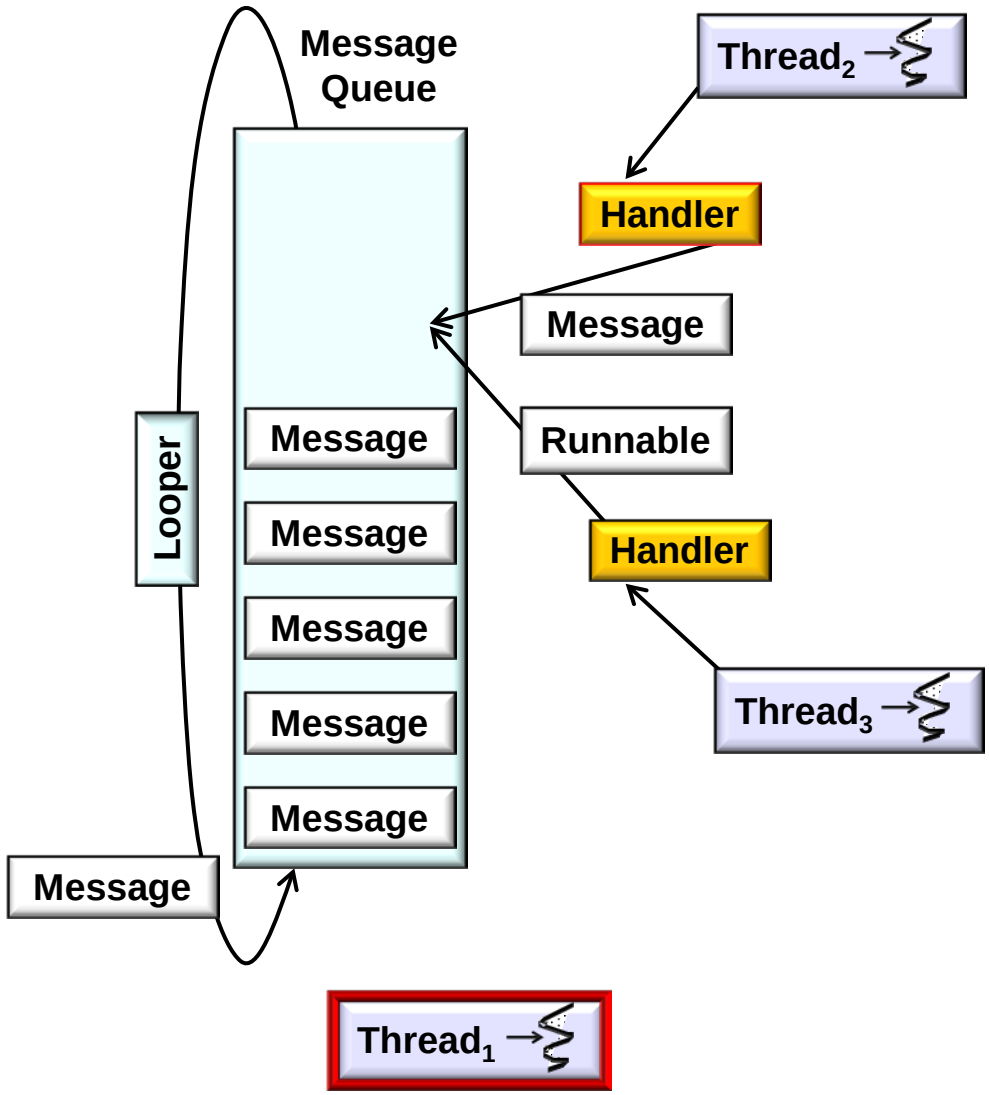

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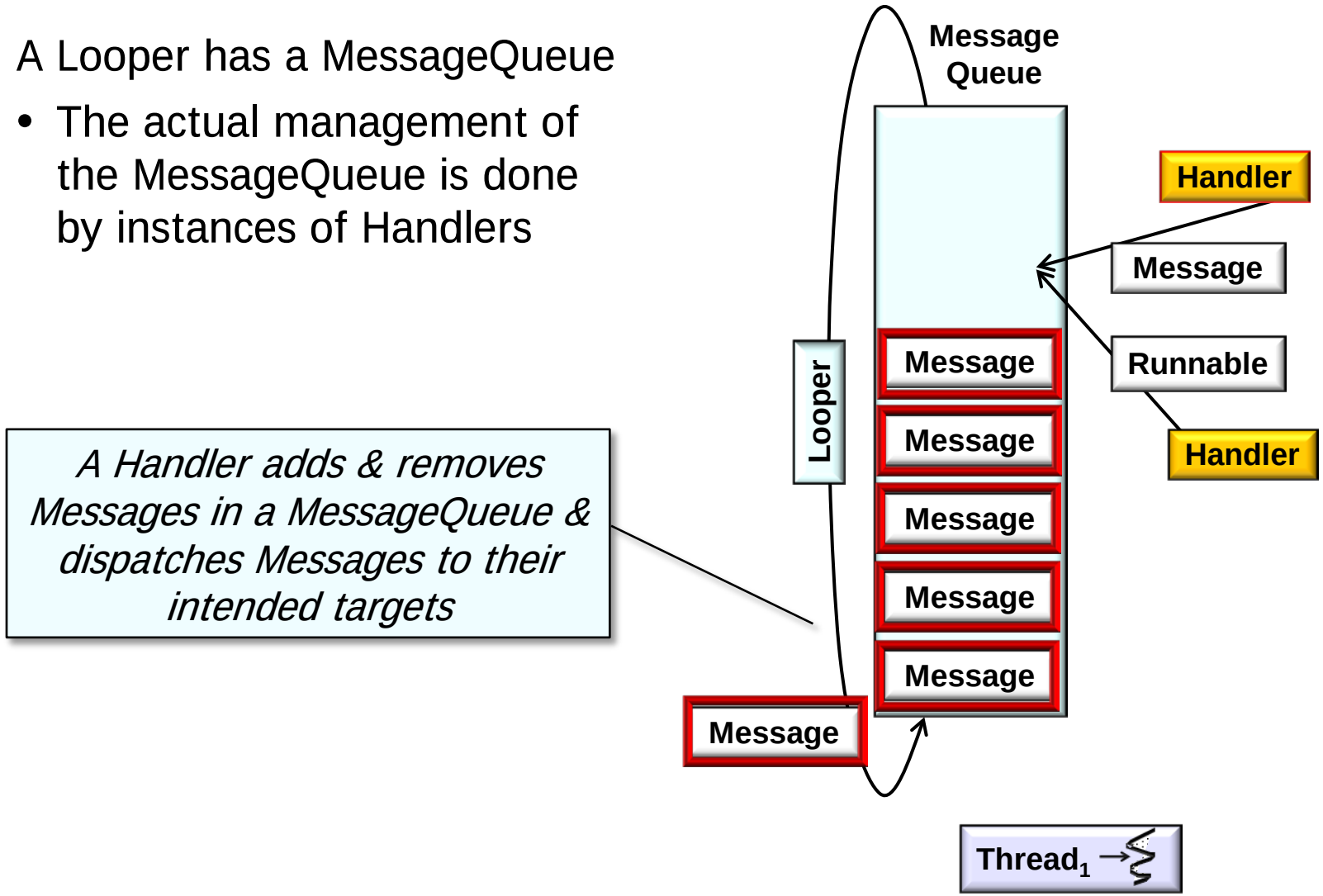

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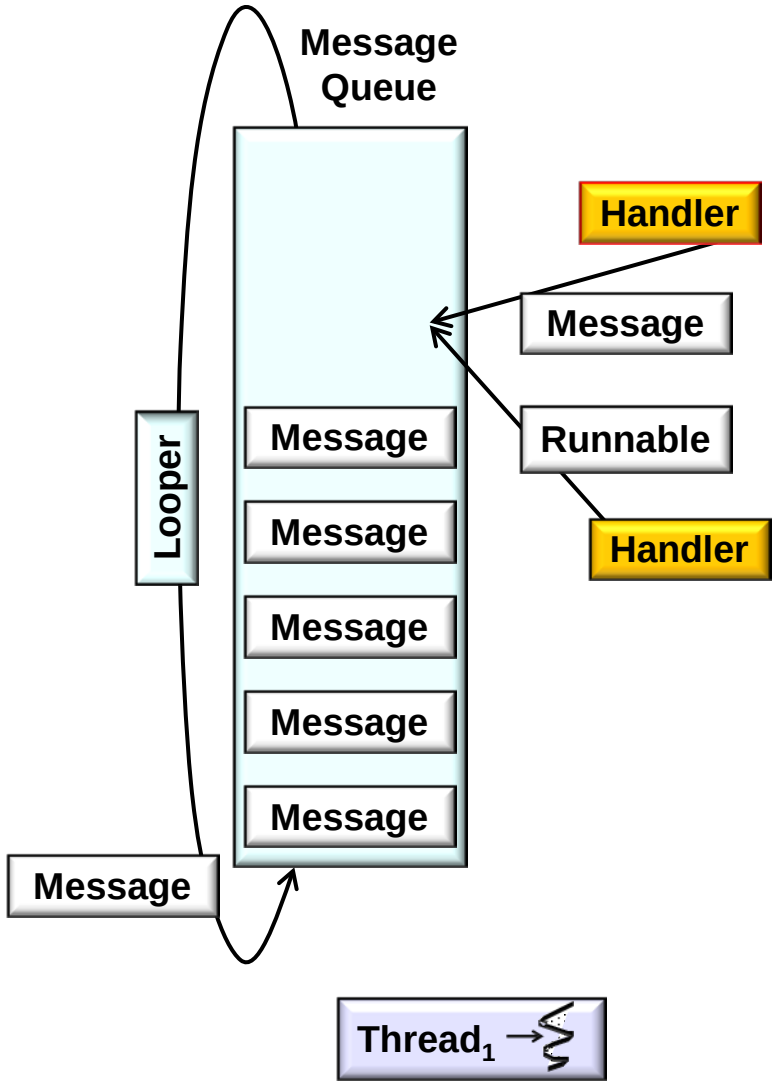

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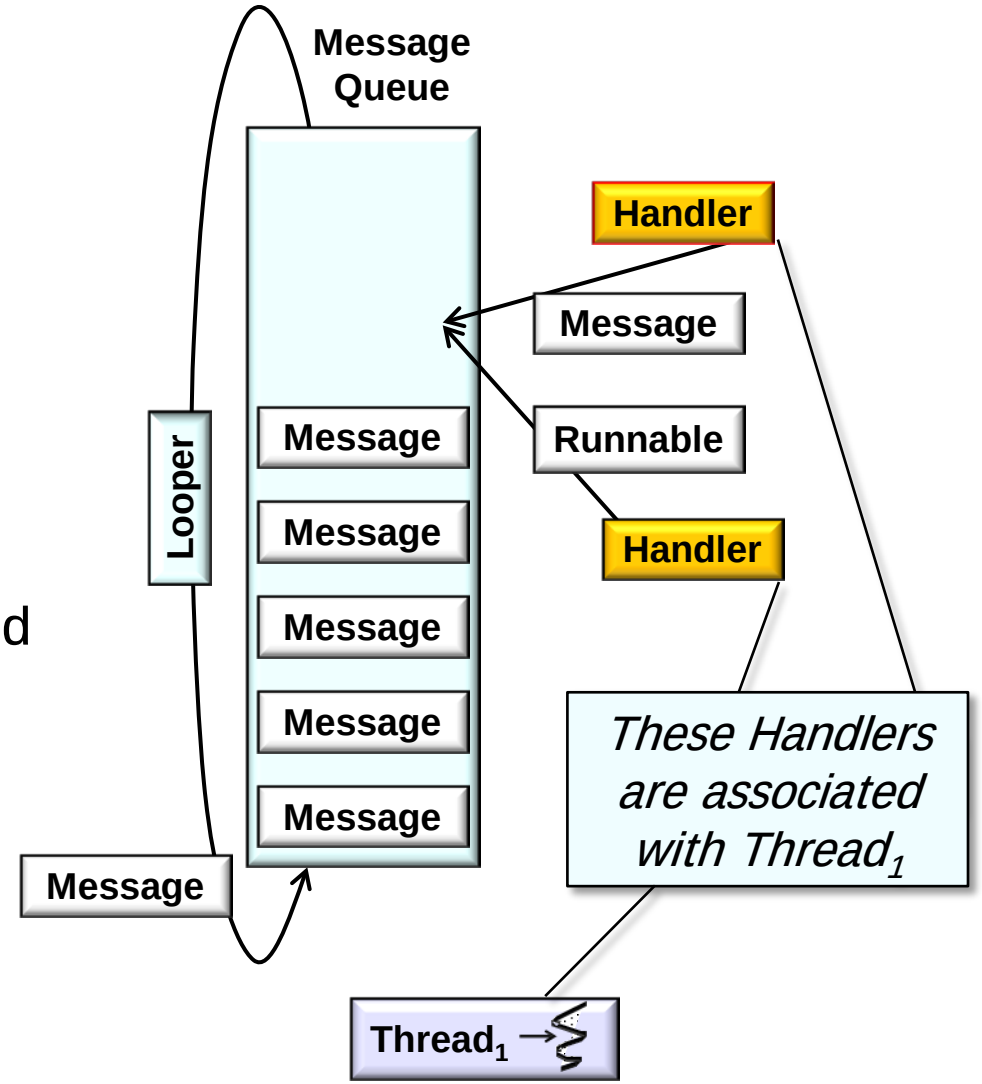

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  - The actual management of the MessageQueue is done by instances of Handlers
  - A Handler is associated with a particular Looper
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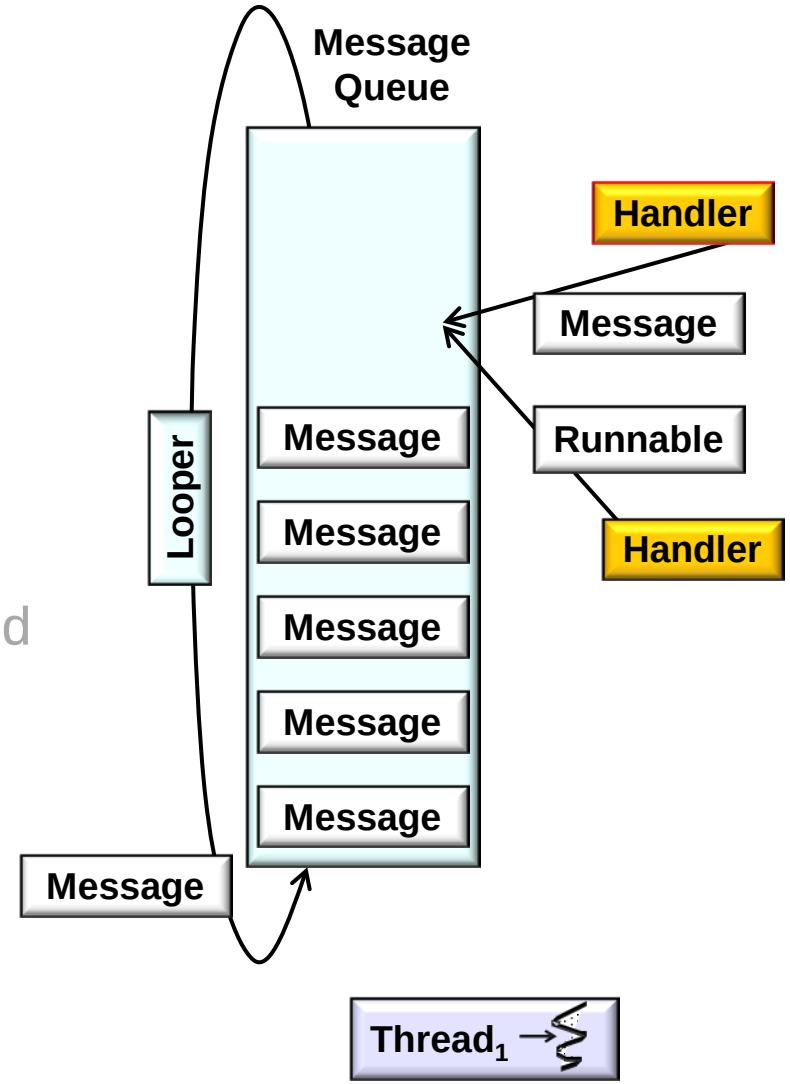
    - A different Looper can be passed as a parameter to the constructor



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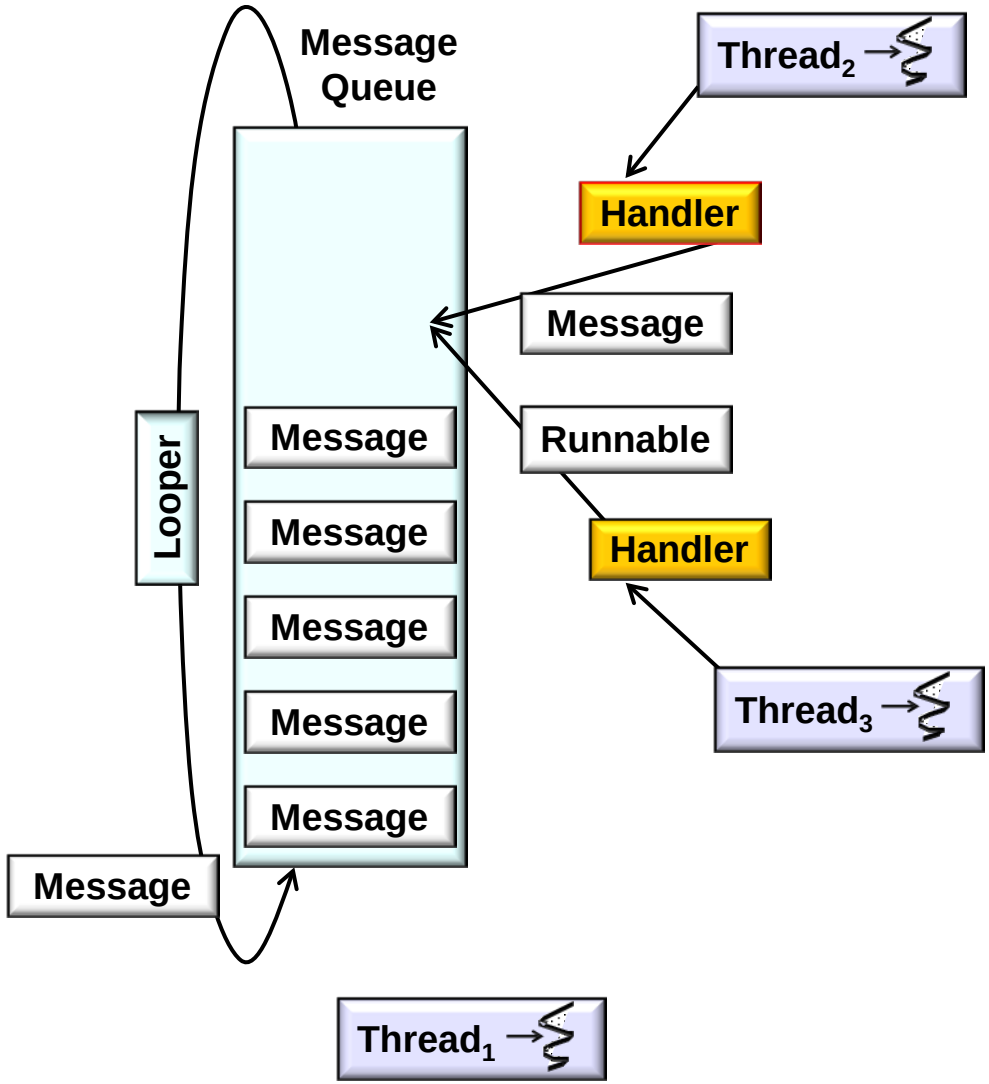
- A Handler provides several capabilities to applications



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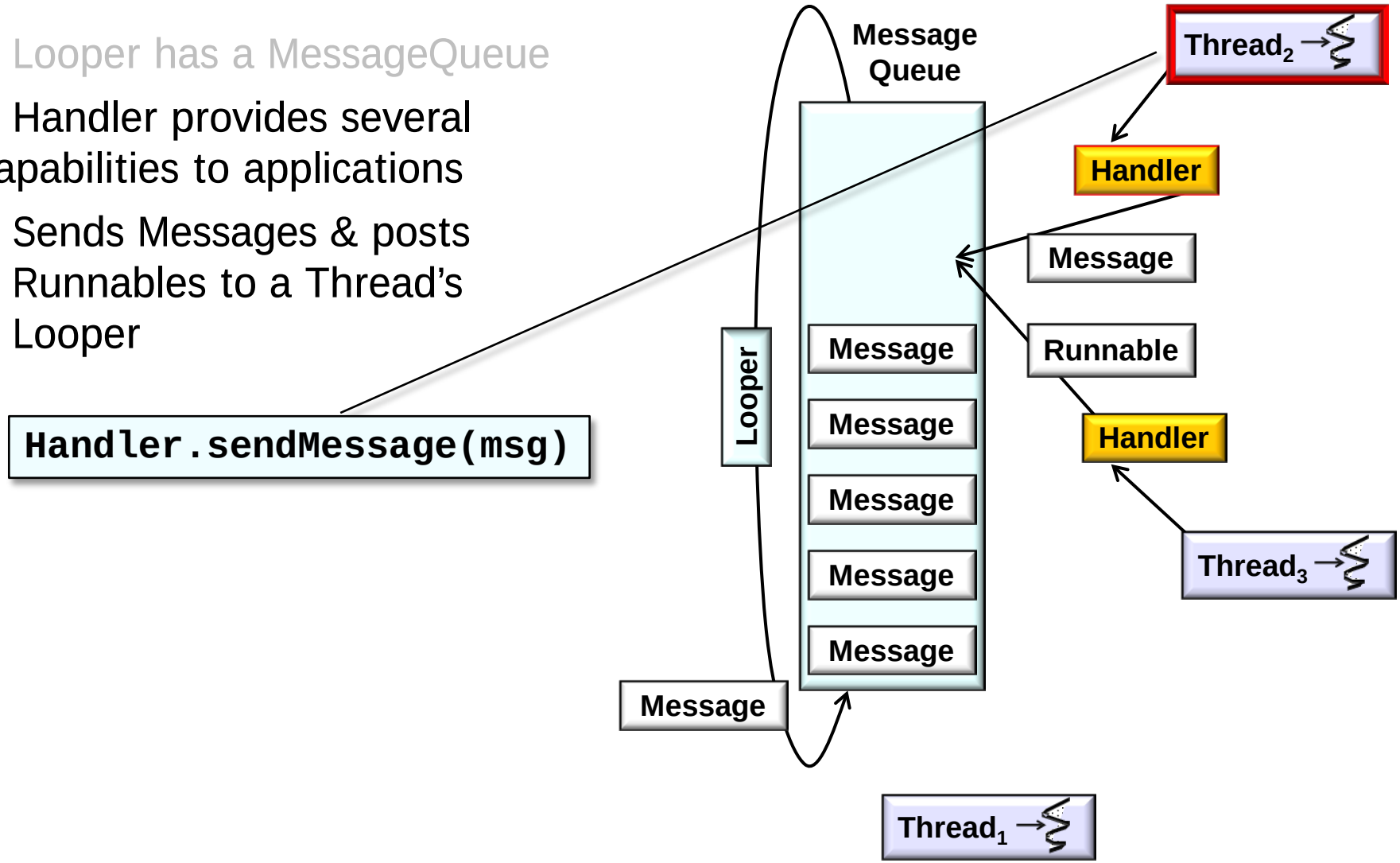
- A Handler provides several capabilities to applications
  - Sends Messages & posts Runnables to a Thread's Looper



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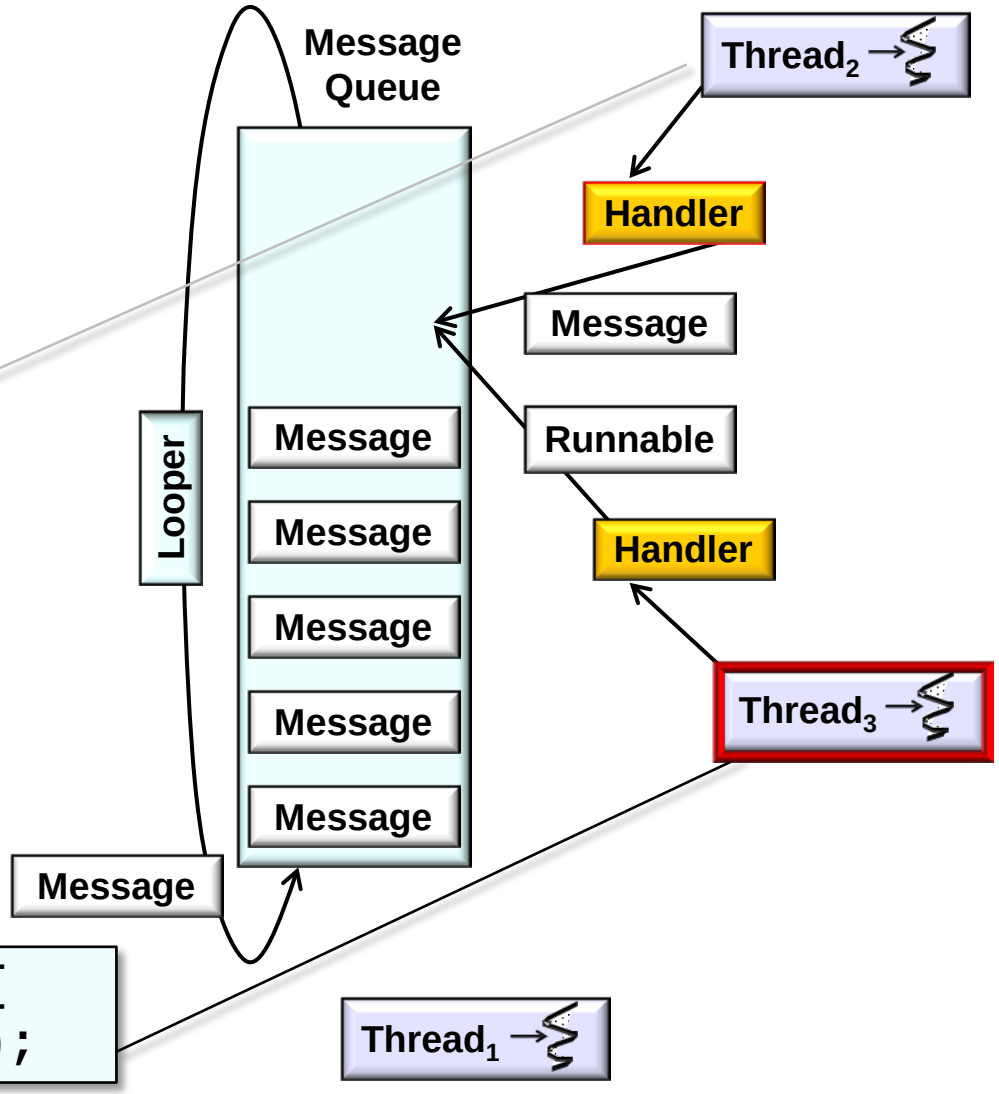
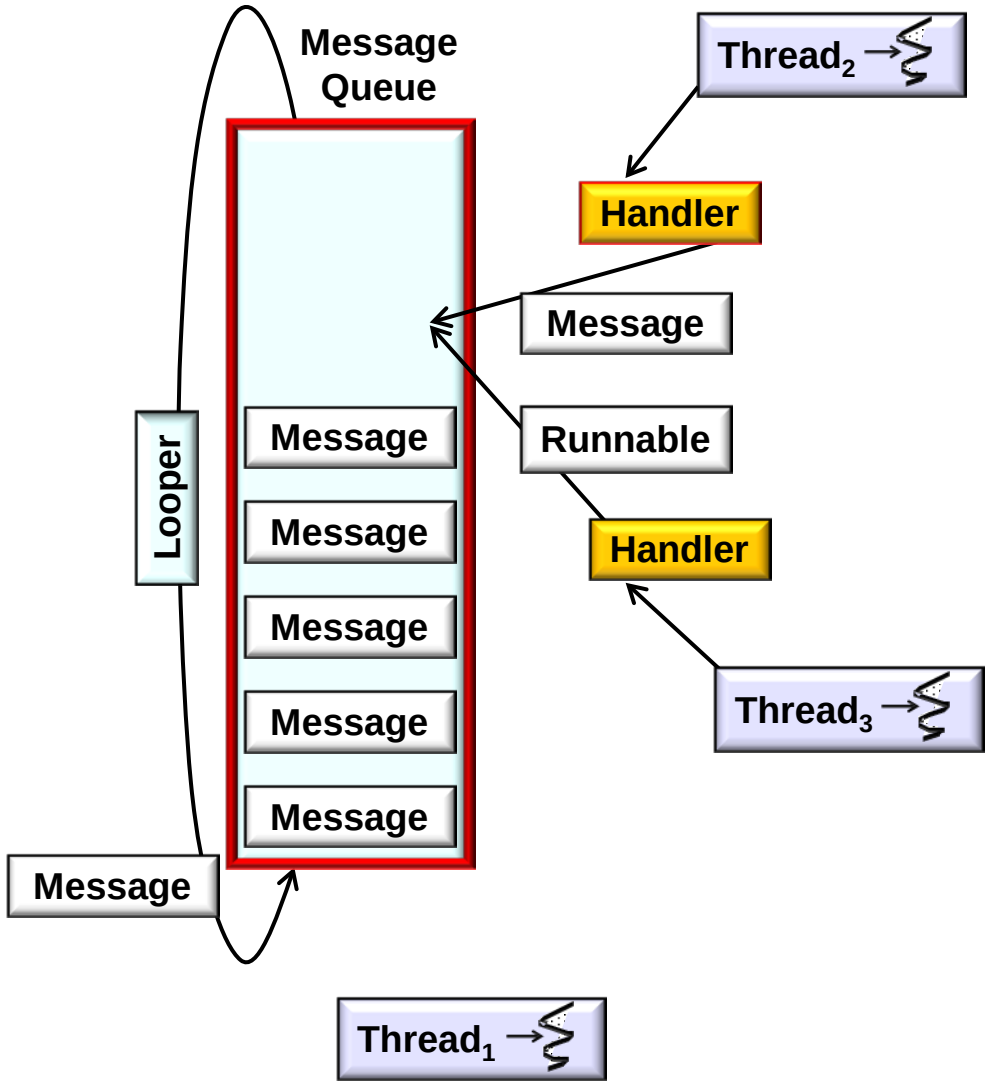
```
Handler.sendMessage(msg)
```




```
Handler.post(new Runnable(){
  public void run(){ ... }});
```

The Handler Class

- A Looper has a MessageQueue
- A Handler provides several capabilities to applications
  - Sends Messages & posts Runnables to a Thread's Looper
    - The Looper's MessageQueue enqueues & schedules them for future execution



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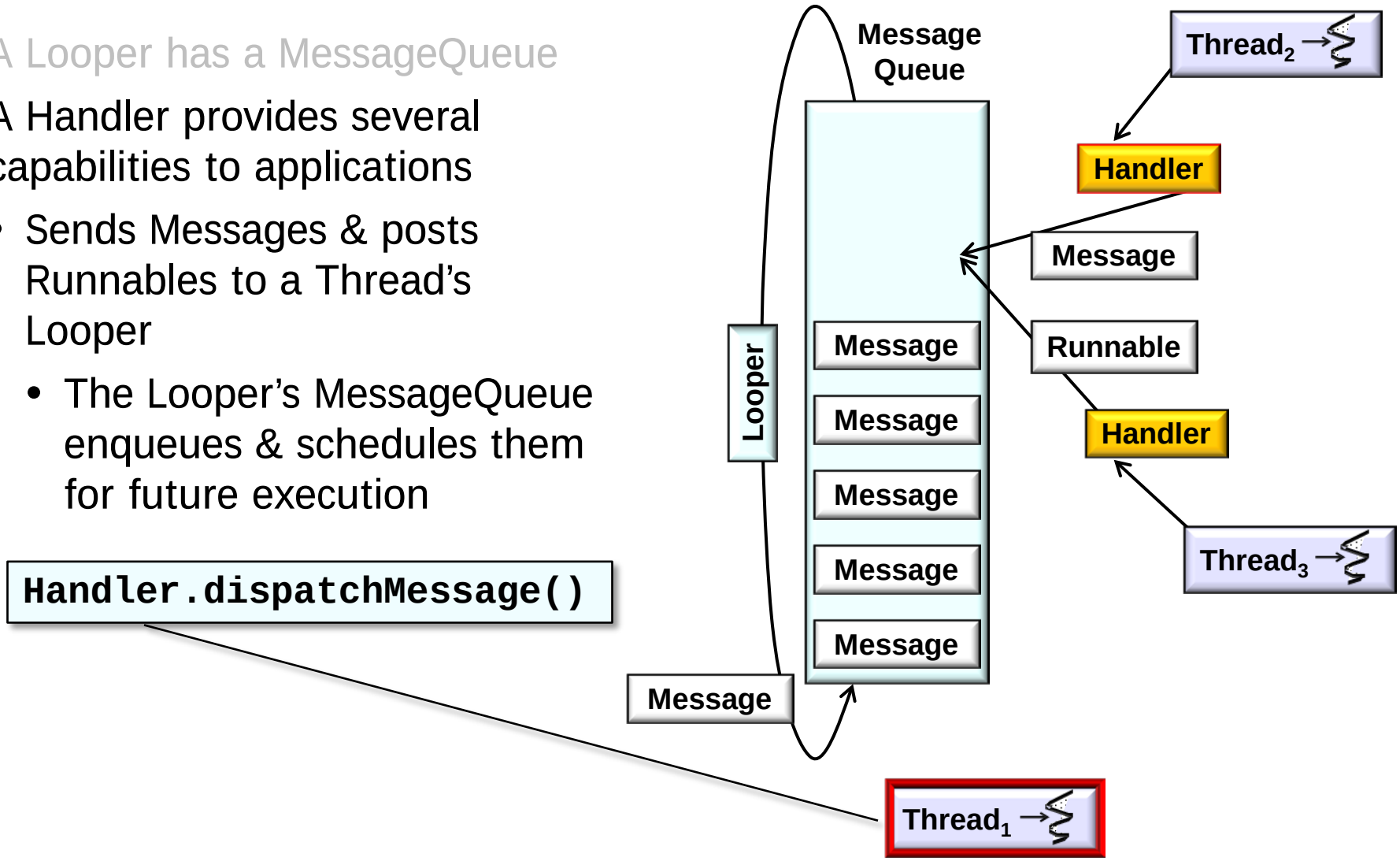

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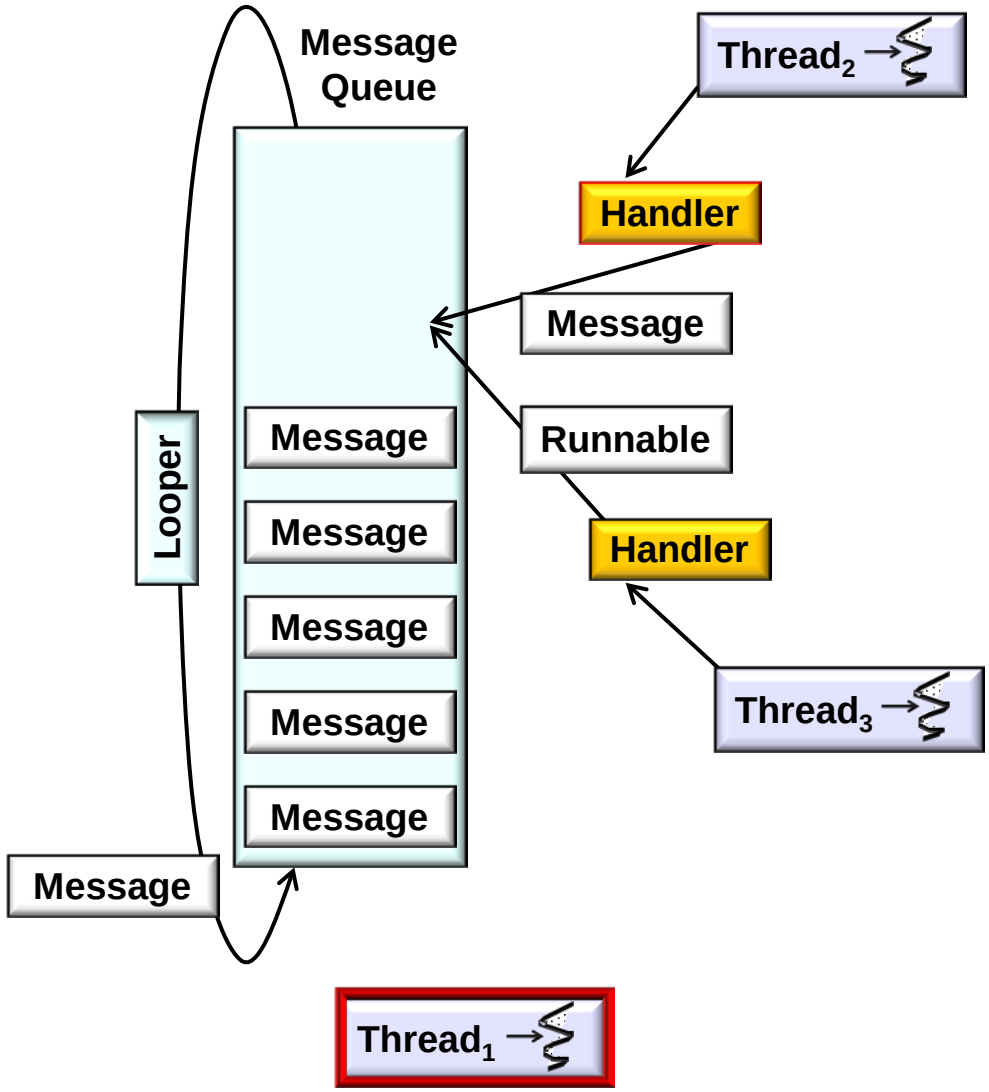
  - Collaborates with Looper to serialize the processing of Messages in a Thread



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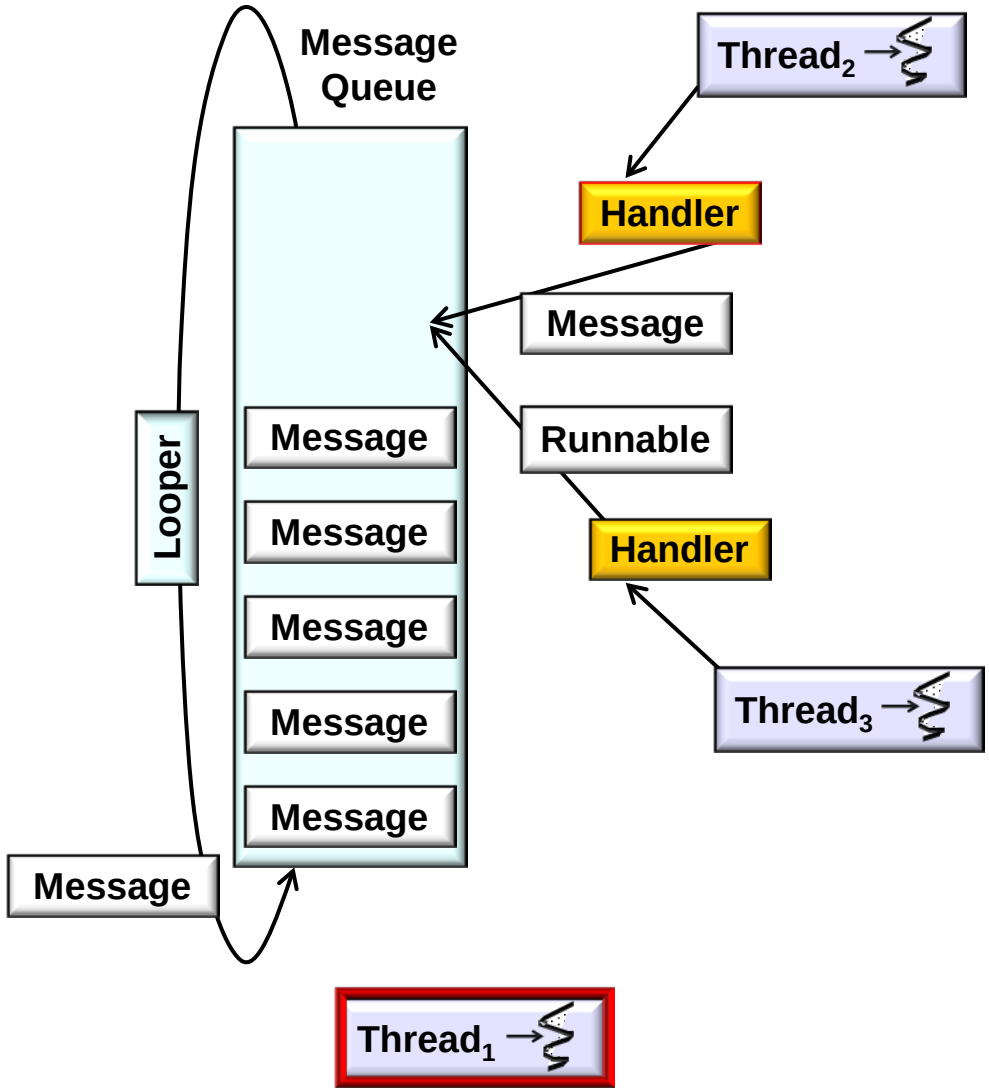
  - Sends Messages & posts Runnables to a Thread's Looper
  - Collaborates with Looper to serialize the processing of Messages in a Thread
    - Can simplify concurrency control if design rules are followed



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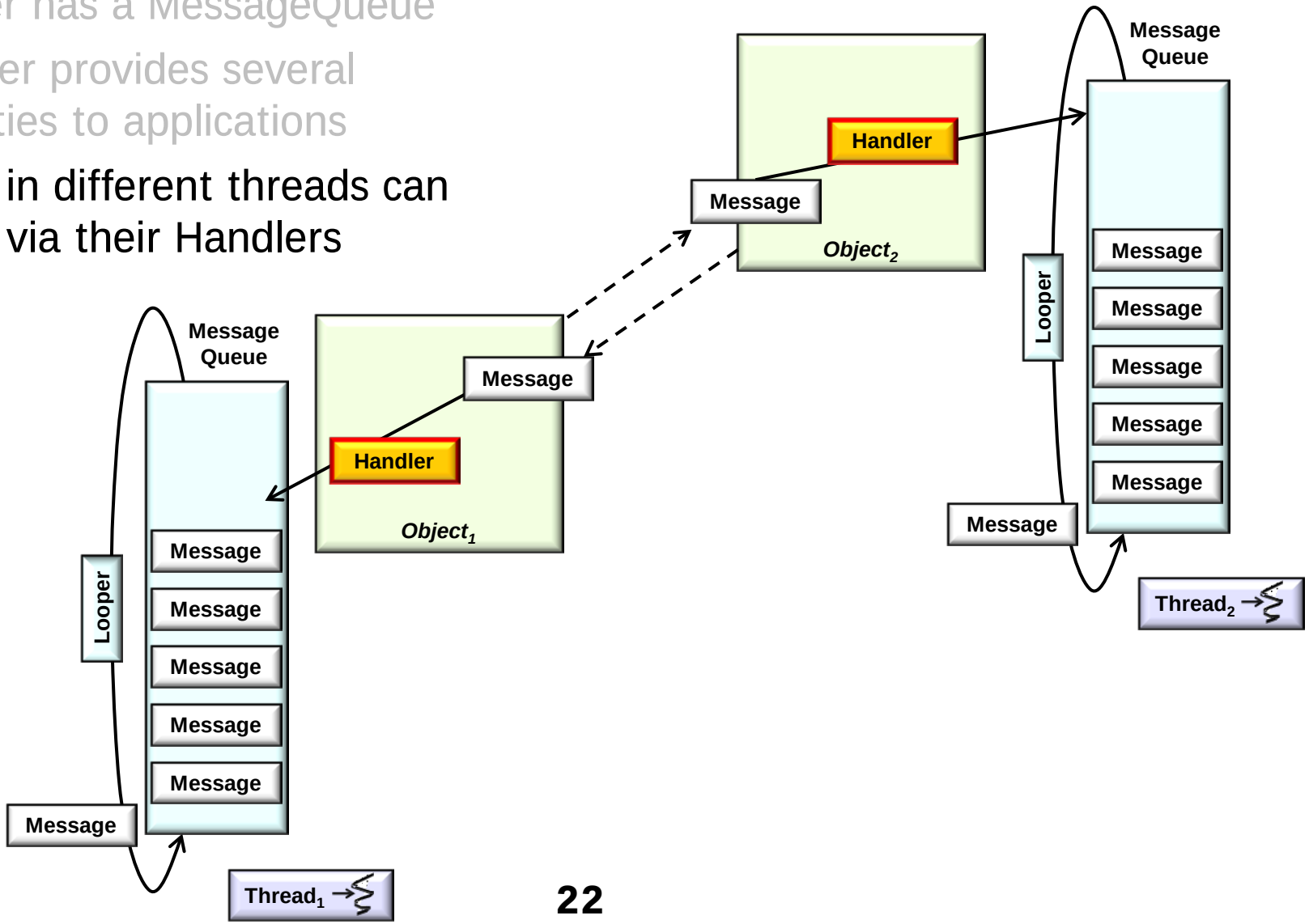
- A Handler provides several capabilities to applications
- Objects in different threads can interact via their Handlers



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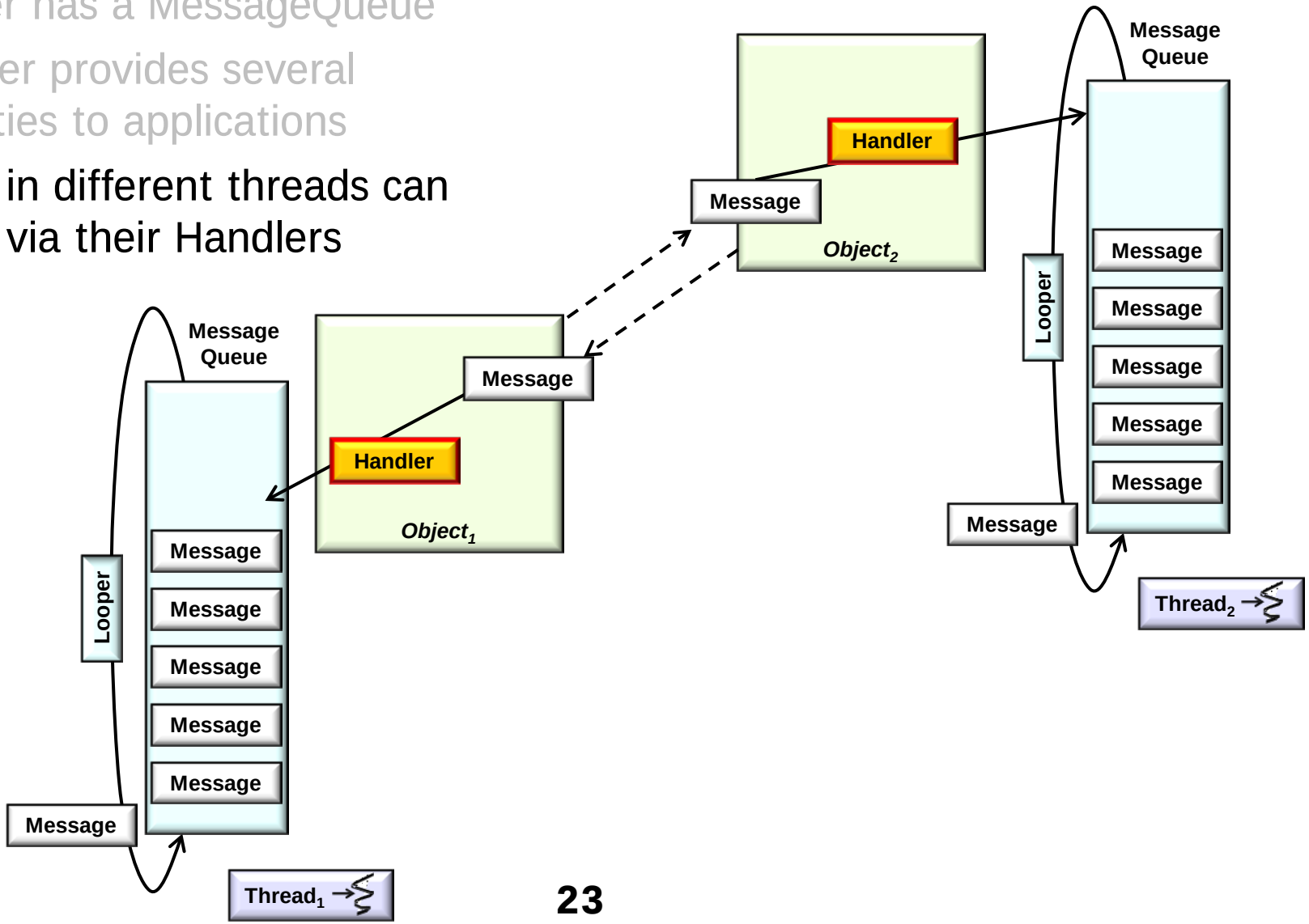

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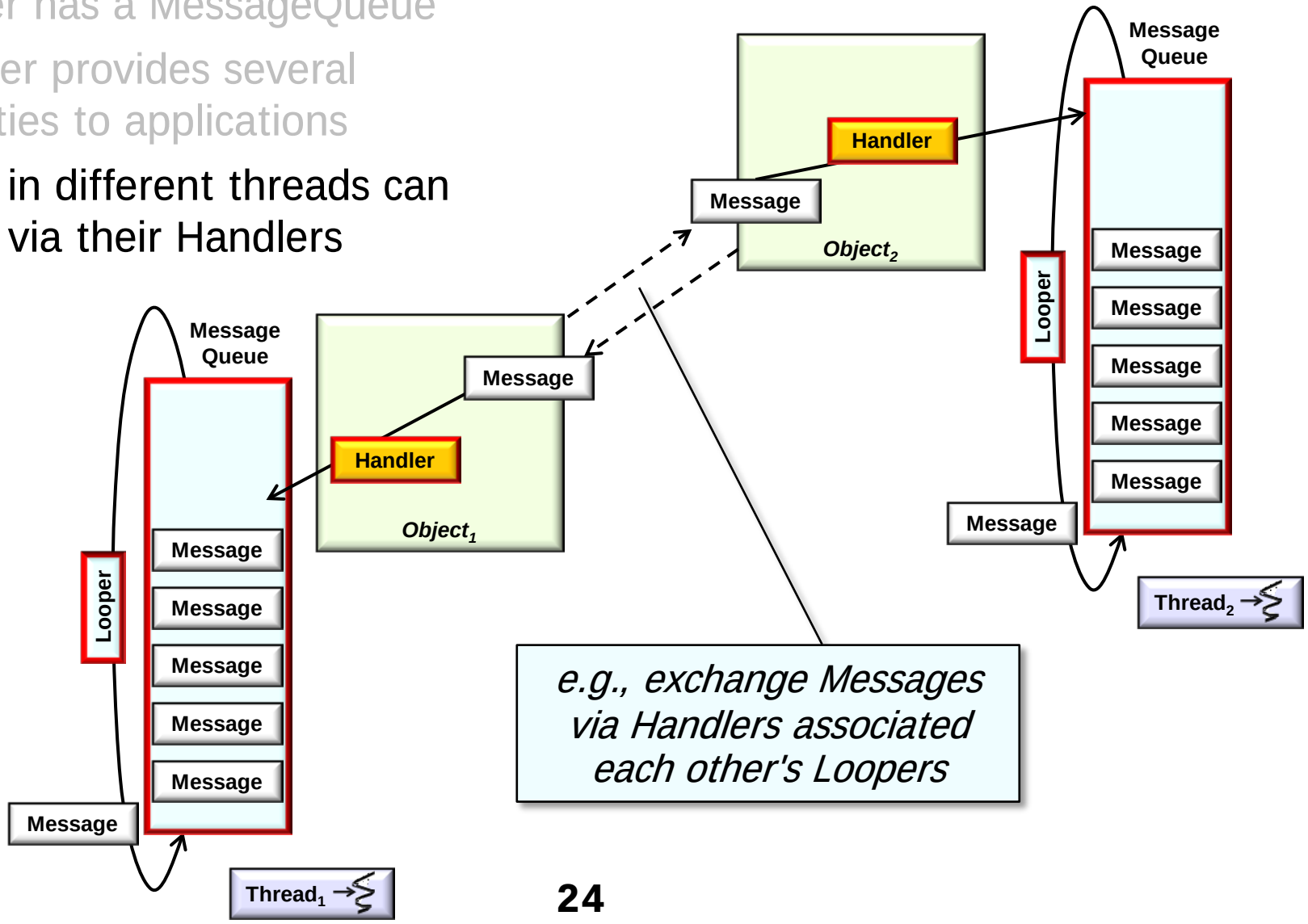

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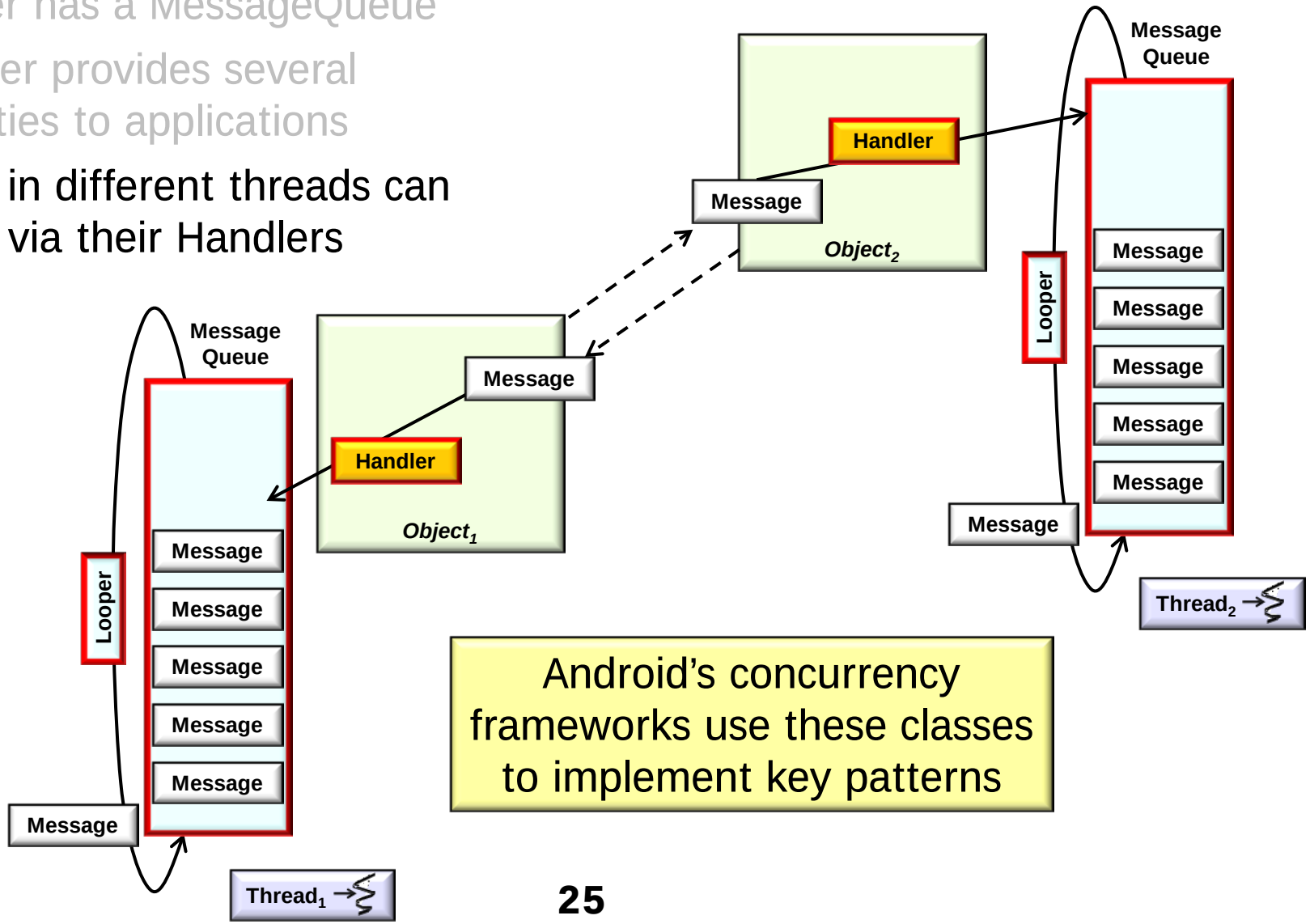

Android's concurrency frameworks use these classes to implement key patterns

Categories of Methods in the Handler Class

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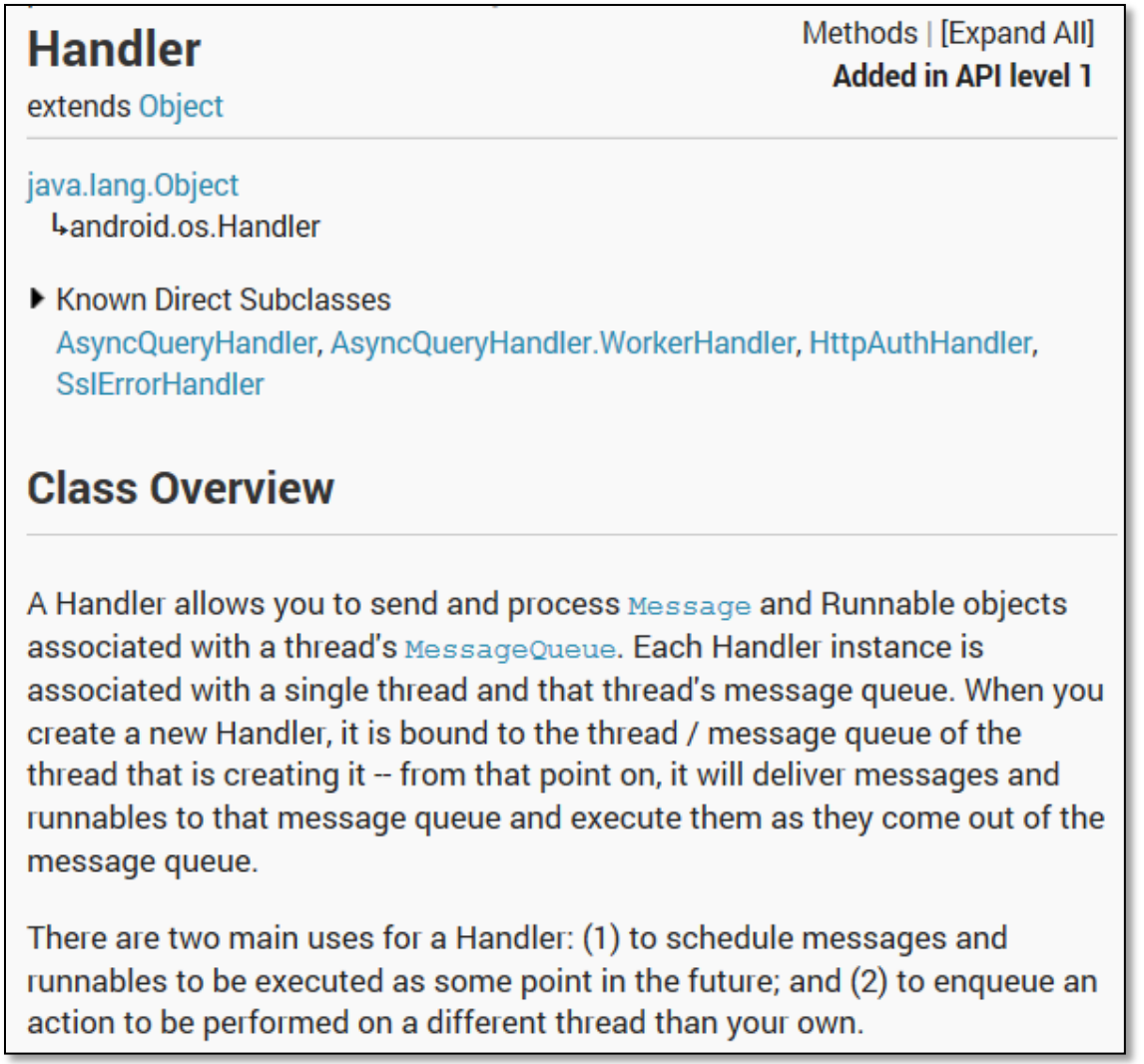
- The Handler class has over two dozen methods



Handler

Methods | [Expand All]
Added in API level 1

extends Object

java.lang.Object
↳android.os.Handler

▸ Known Direct Subclasses
AsyncQueryHandler, AsyncQueryHandler.WorkerHandler, HttpAuthHandler, SslErrorHandler

Class Overview

A Handler allows you to send and process `Message` and Runnable objects associated with a thread's `MessageQueue`. Each Handler instance is associated with a single thread and that thread's message queue. When you create a new Handler, it is bound to the thread / message queue of the thread that is creating it -- from that point on, it will deliver messages and runnables to that message queue and execute them as they come out of the message queue.

There are two main uses for a Handler: (1) to schedule messages and runnables to be executed as some point in the future; and (2) to enqueue an action to be performed on a different thread than your own.

developer.android.com/reference/android/os/Handler.html has more info

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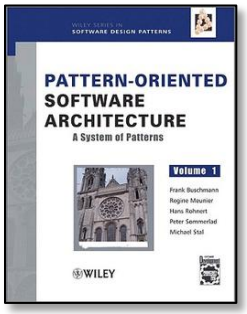

Categories of Methods in the Handler Class

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- These methods can be grouped into four main categories
  - Posting/removing Runnables

`boolean post(Runnable r)`

- Add Runnable to MessageQueue & run when MessageQueue is ready

`void removeCallbacks(Runnable r)`

- Remove any pending posts of Runnable r that are in the MessageQueue

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    - The Handler & its Thread-specific Looper dequeue each Runnable & dispatch it's run() hook method

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- Puts msg at end of queue immediately

`void removeMessages(int what)`

- Remove any pending posts of Messages with code ‘what’ that are in the MessageQueue

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  - Obtaining Messages

`Message obtainMessage()`

- Returns a new Message from the global message pool

`Message obtainMessage (int what)`

- Same as obtainMessage(), except that it also sets the what member of the returned Message

`Message obtainMessage (int what, int arg1, int arg2, Object obj)`

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    - Factories that create Messages passed to sendMessage()

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See en.wikipedia.org/wiki/Creational_pattern

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  - Dispatching/handling Messages

`void dispatchMessage(Message msg)`

- Invoke the appropriate callback (e.g., run() or handleMessage()) based on the type of the Message

`void handleMessage(Message msg)`

- Subclasses must implement this method to receive messages

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    - handleMessage() runs in the context of the Handler Thread

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See upcoming parts on the "*Active Object* pattern"

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The next two parts of the module cover these Handler methods in more detail

Summary

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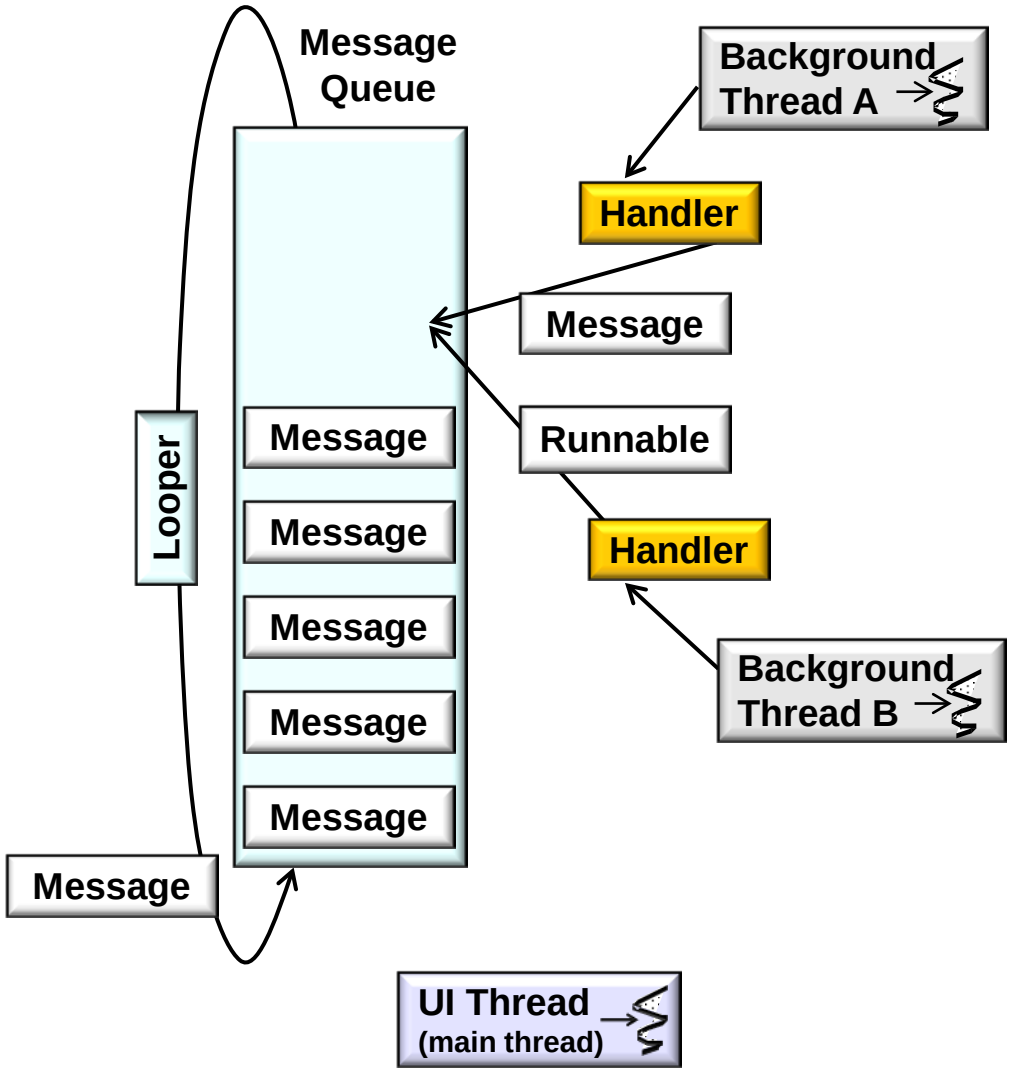
- UI & background threads often need to communicate



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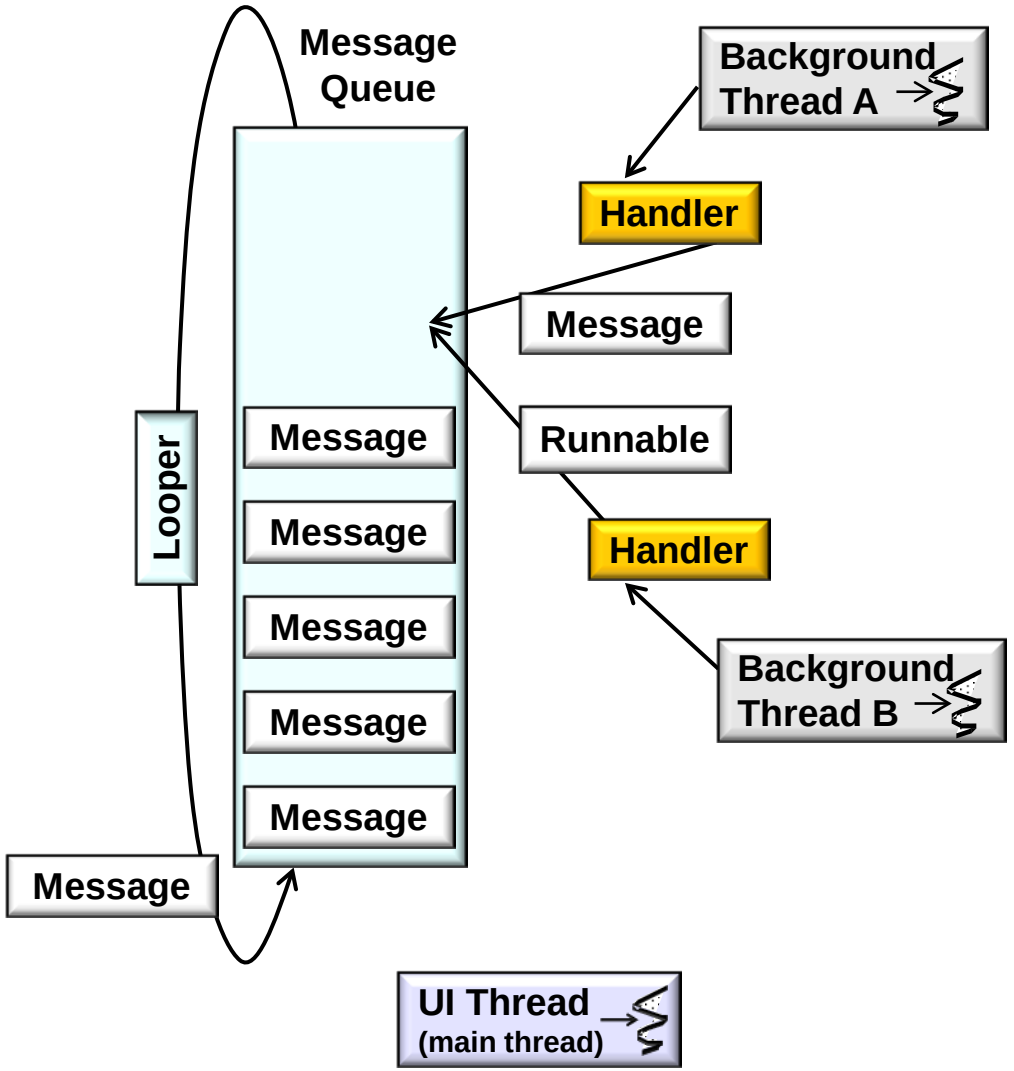
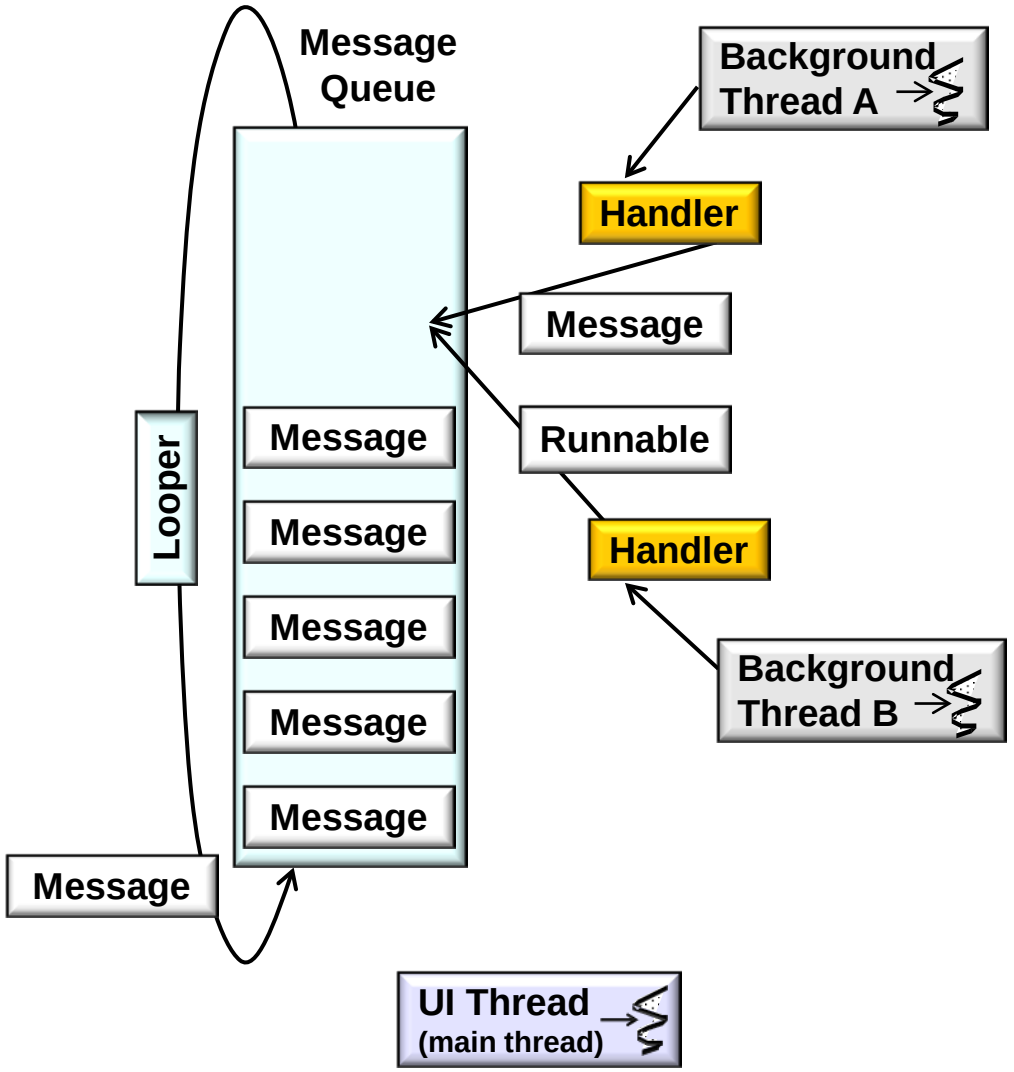
  - To perform their operations concurrently



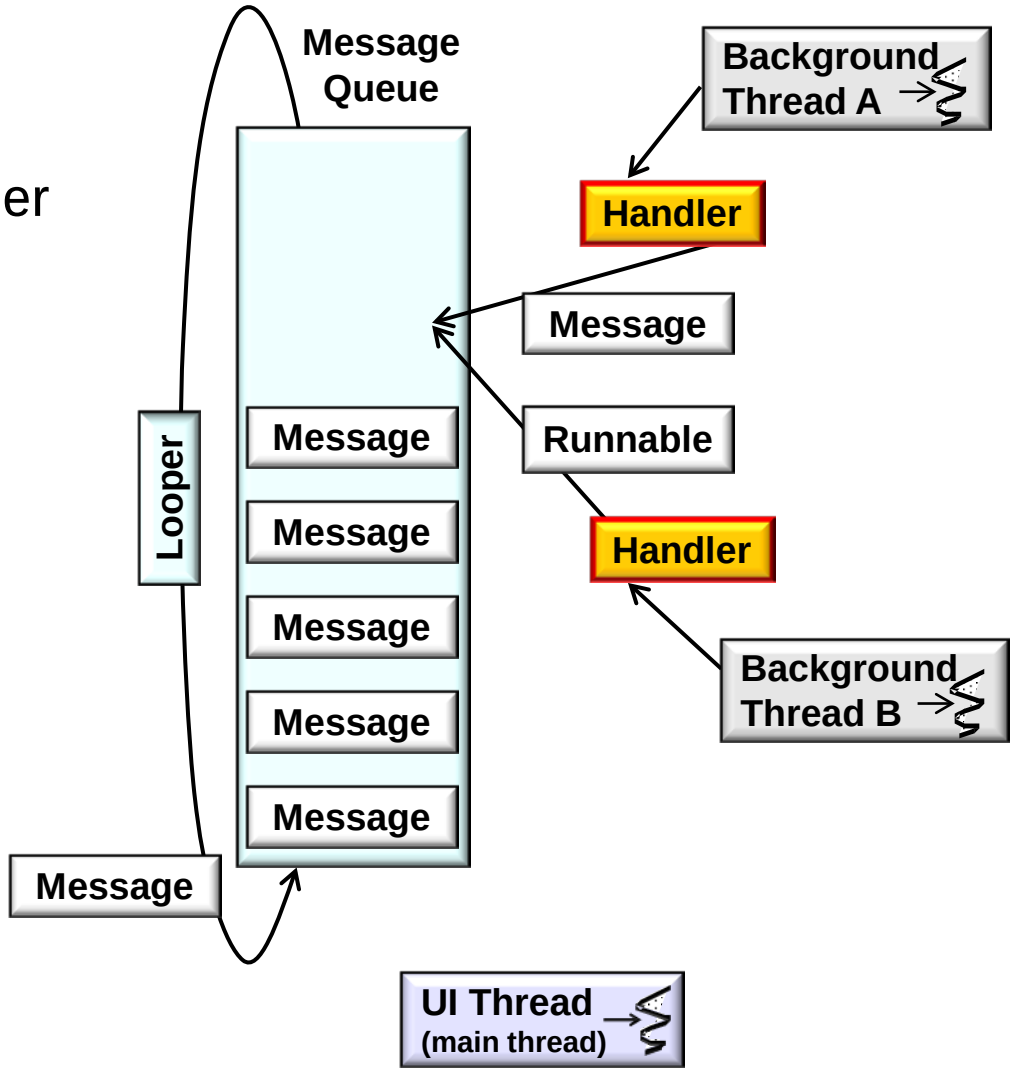
Summary

- UI & background threads often need to communicate, e.g.
  - To perform their operations concurrently
  - To coordinate their behavior



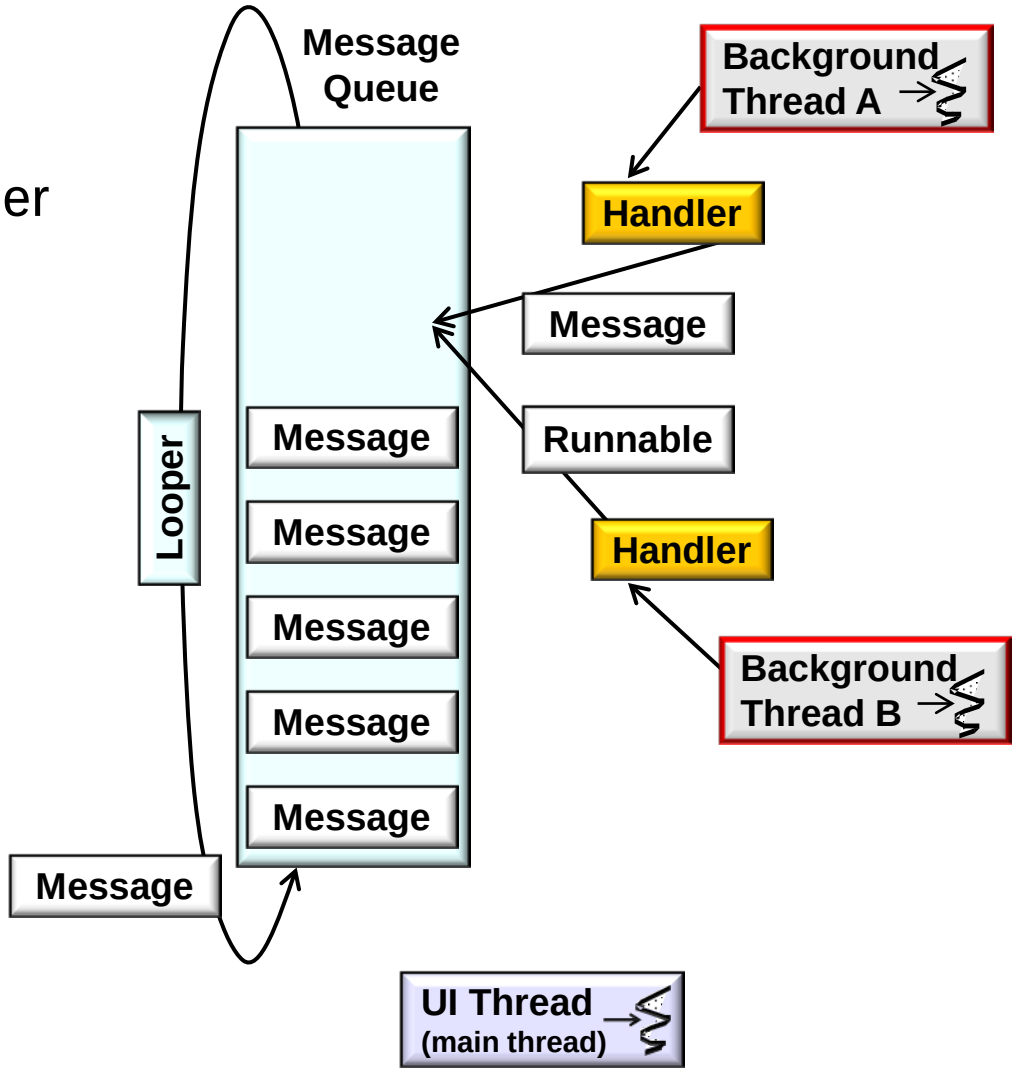
Summary

- UI & background threads often need to communicate
- HaMeR framework provides Handler class to support this use case



Summary

- UI & background threads often need to communicate
- HaMeR framework provides Handler class to support this use case
  - A Handler allows background Threads to send Messages or post Runnables to the UI Thread's MessageQueue



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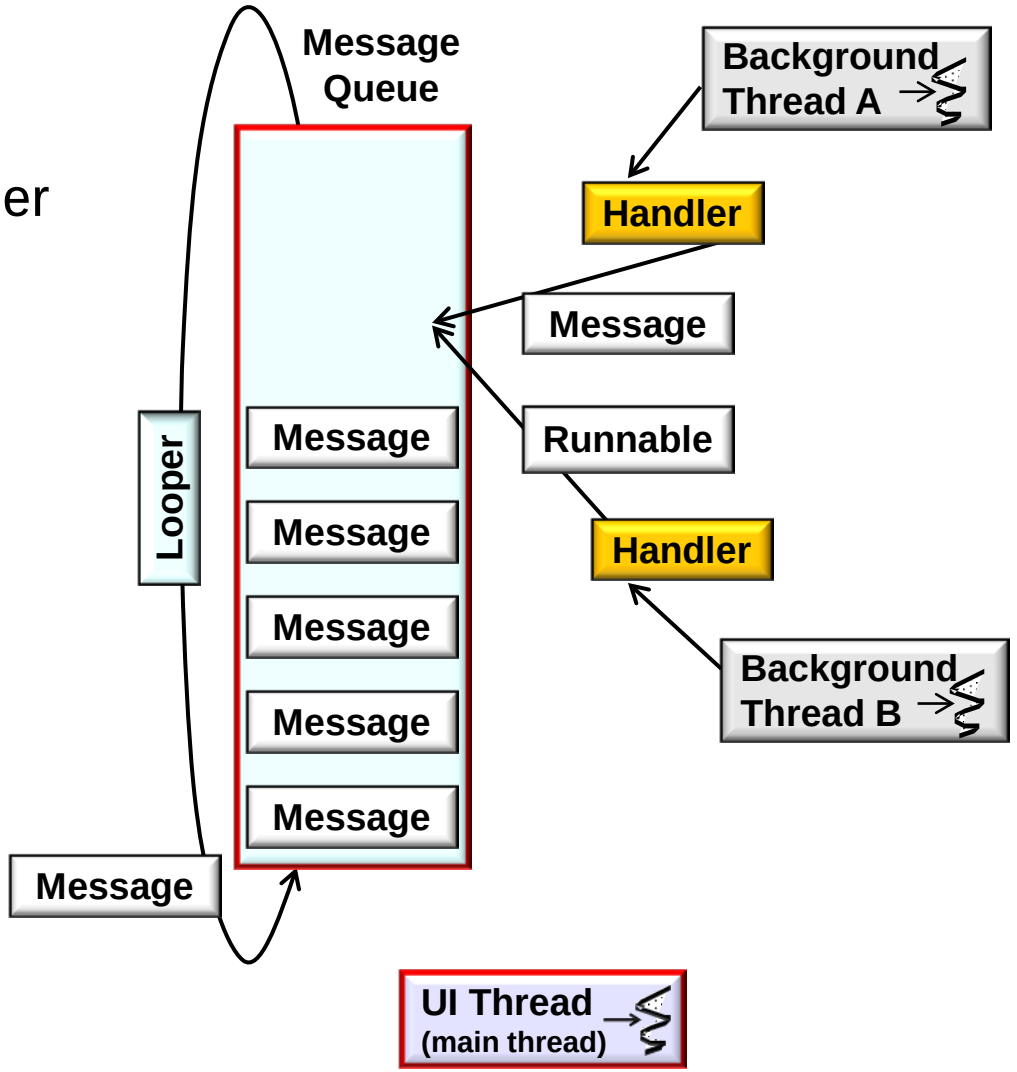
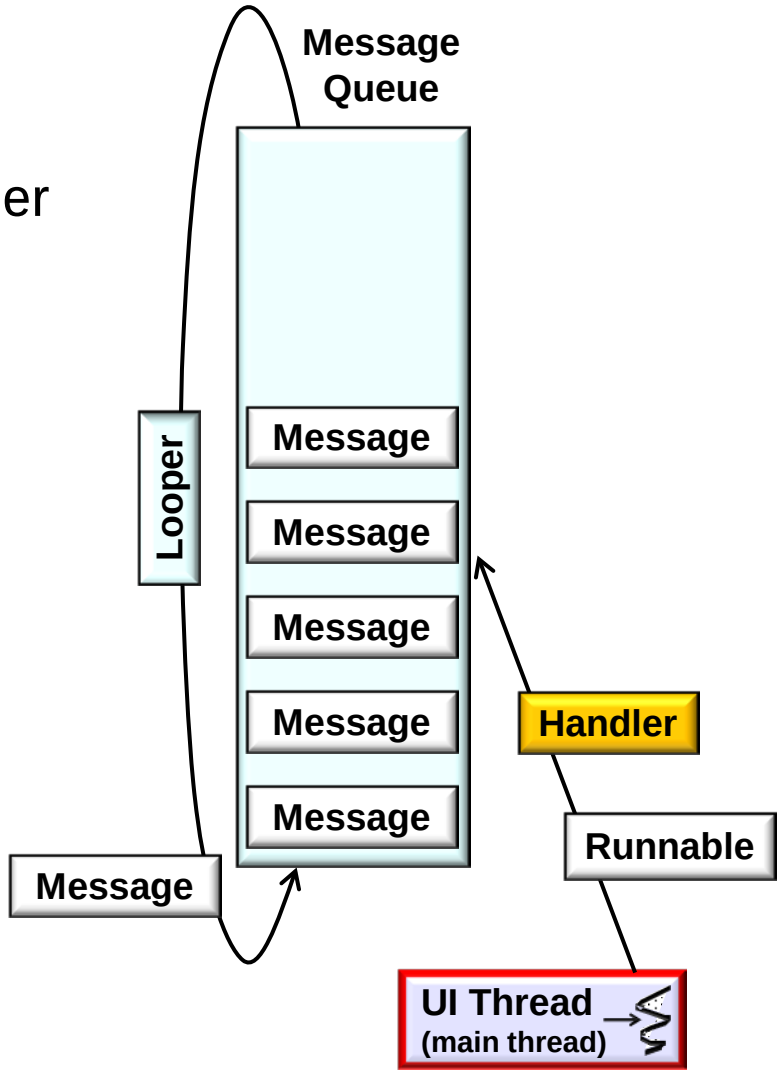


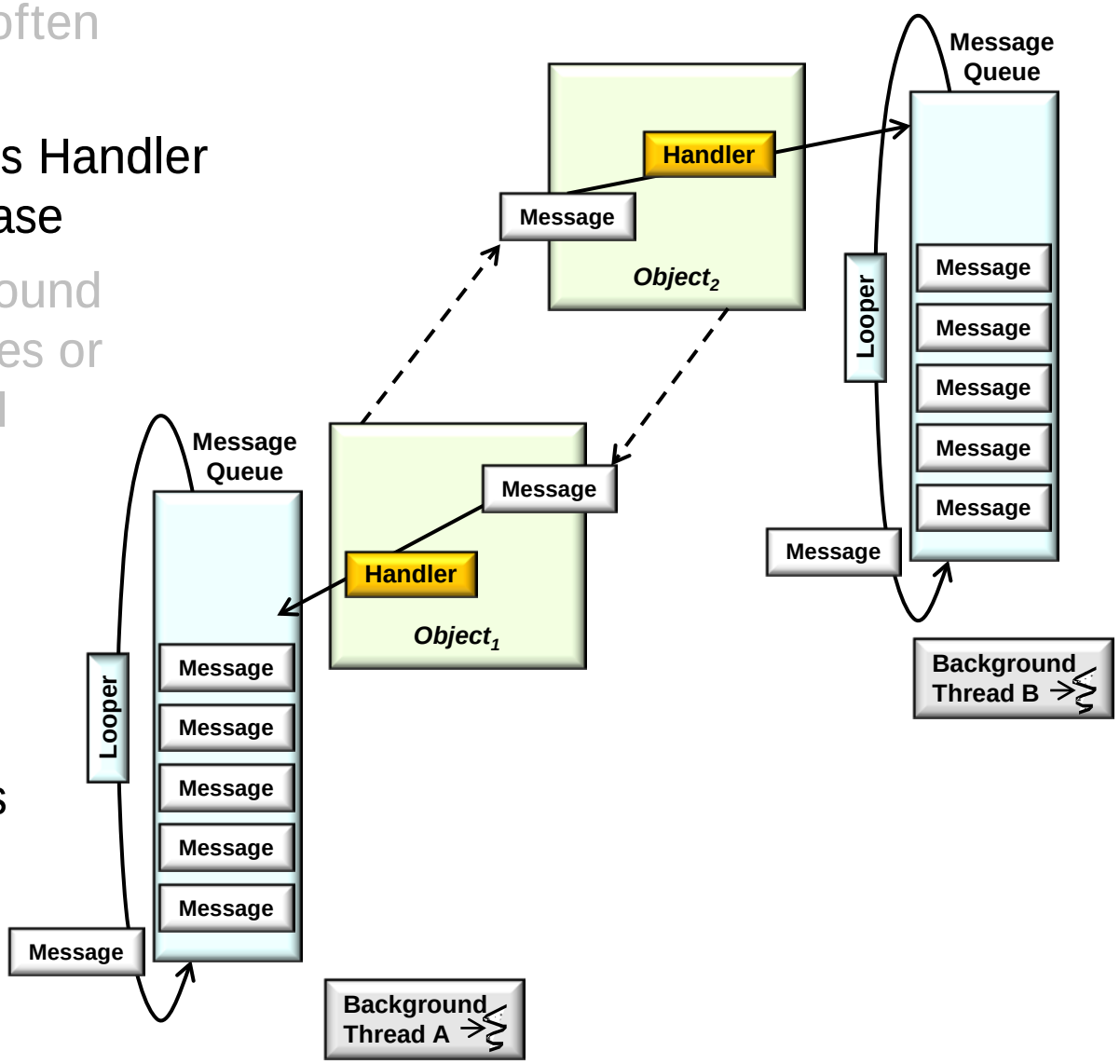
Summary

- UI & background threads often need to communicate
- HaMeR framework provides Handler class to support this use case
  - A Handler allows background Threads to send Messages or post Runnables to the UI Thread's MessageQueue
  - It can also allow a Thread to send/post to itself



Summary

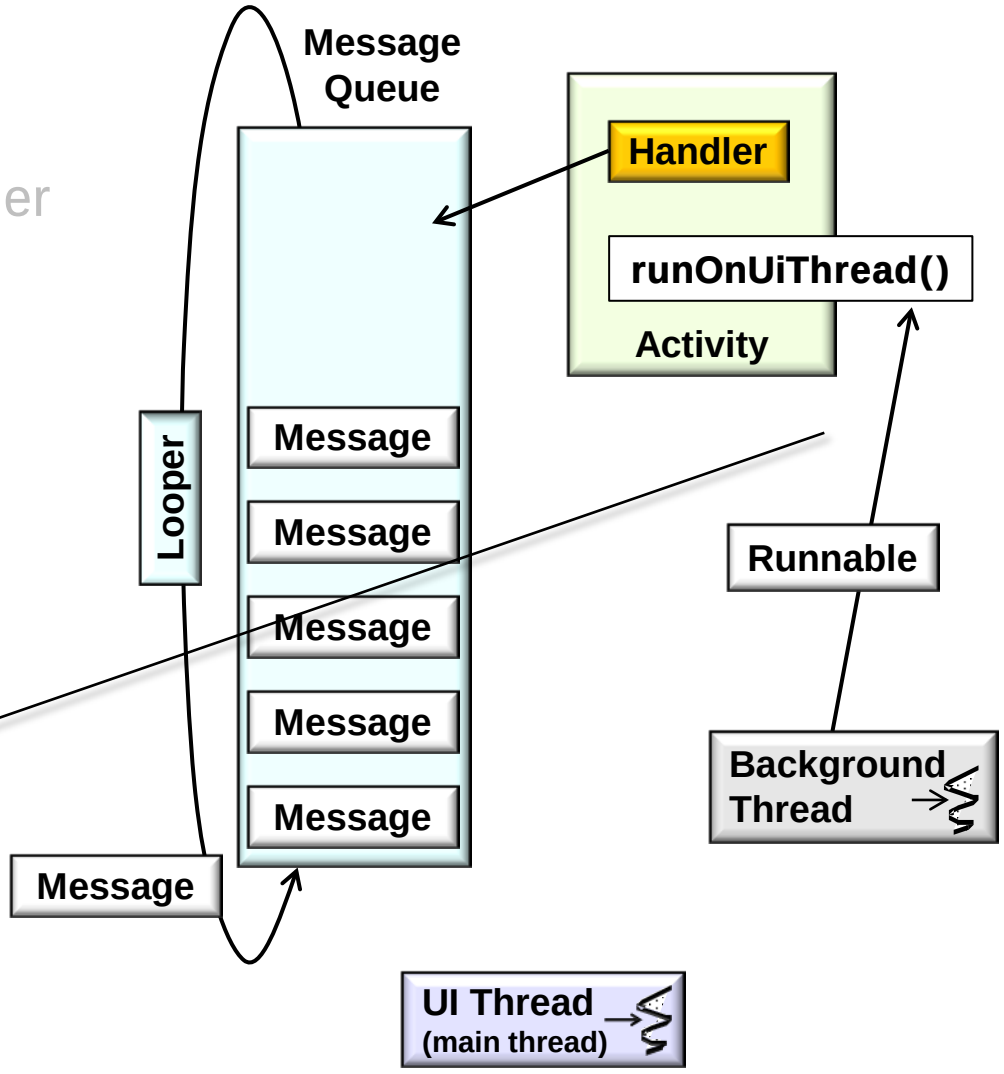
- UI & background threads often need to communicate
- HaMeR framework provides Handler class to support this use case
  - A Handler allows background Threads to send Messages or post Runnables to the UI Thread's MessageQueue
  - It can also allow a Thread to send/post to itself
  - Background Threads can interact via Handlers



Summary

- UI & background threads often need to communicate
- HaMeR framework provides Handler class to support this use case
- post() methods used when senders know what operations to perform

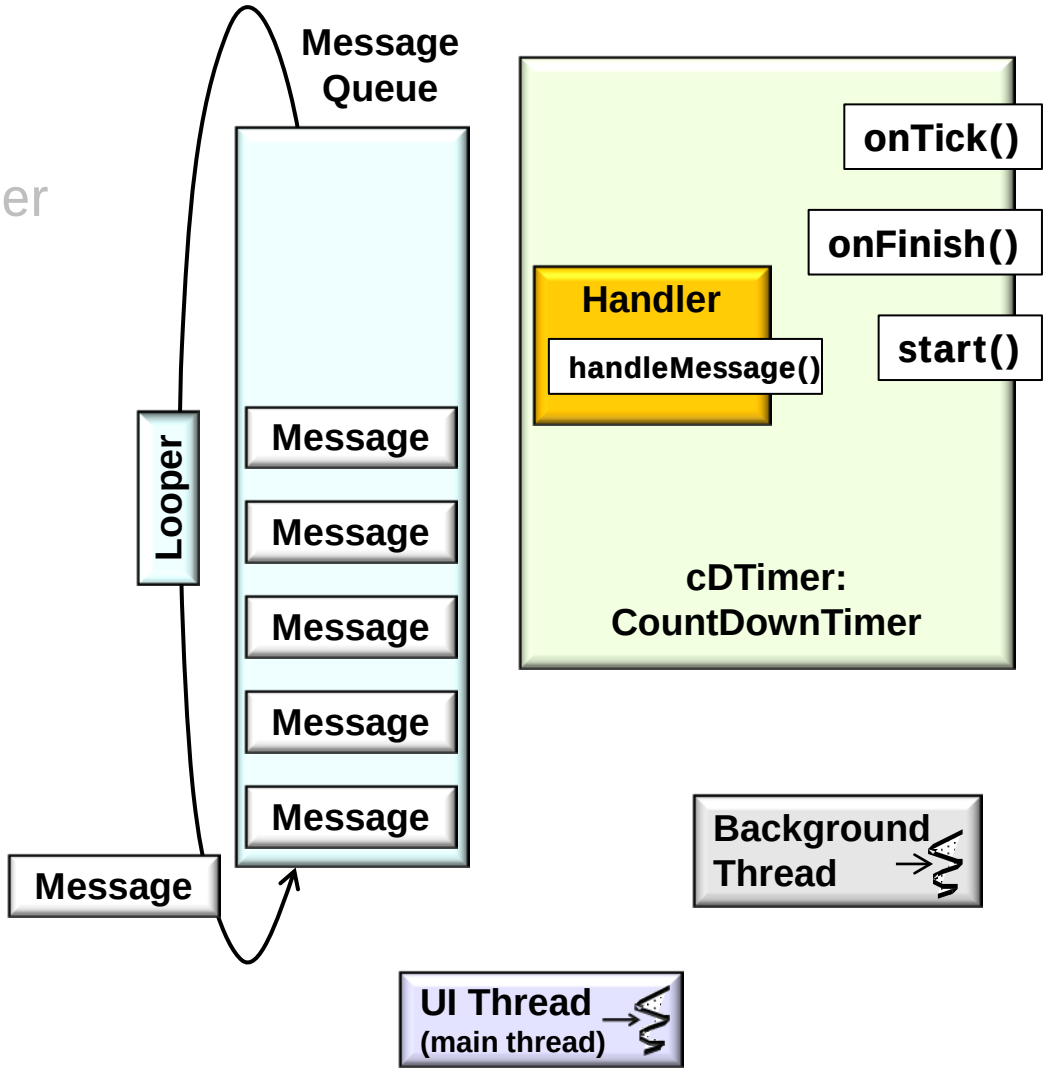
```
runOnUiThread
  (new Runnable() {
     public void run()
       { ... }
  });
```



See upcoming part on “Posting & Processing Runnables with Android Handler”

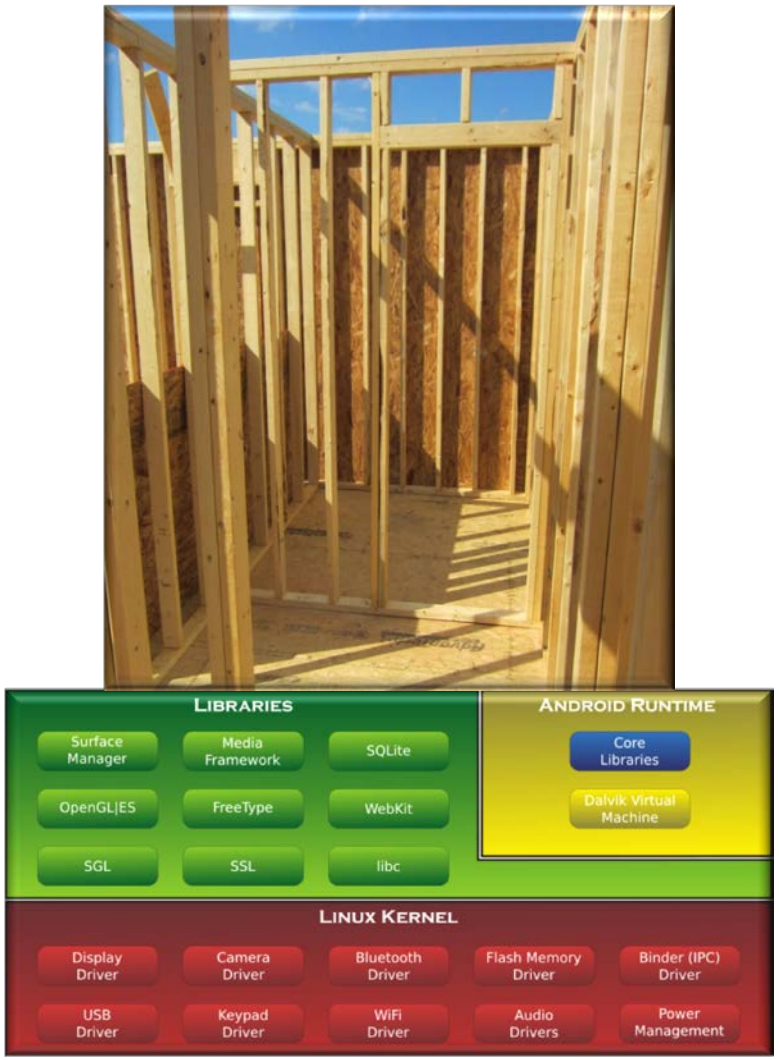
Summary

- UI & background threads often need to communicate
- HaMeR framework provides Handler class to support this use case
- post() methods used when senders know what operations to perform
- sendMethod() methods used when receivers know what operations to perform



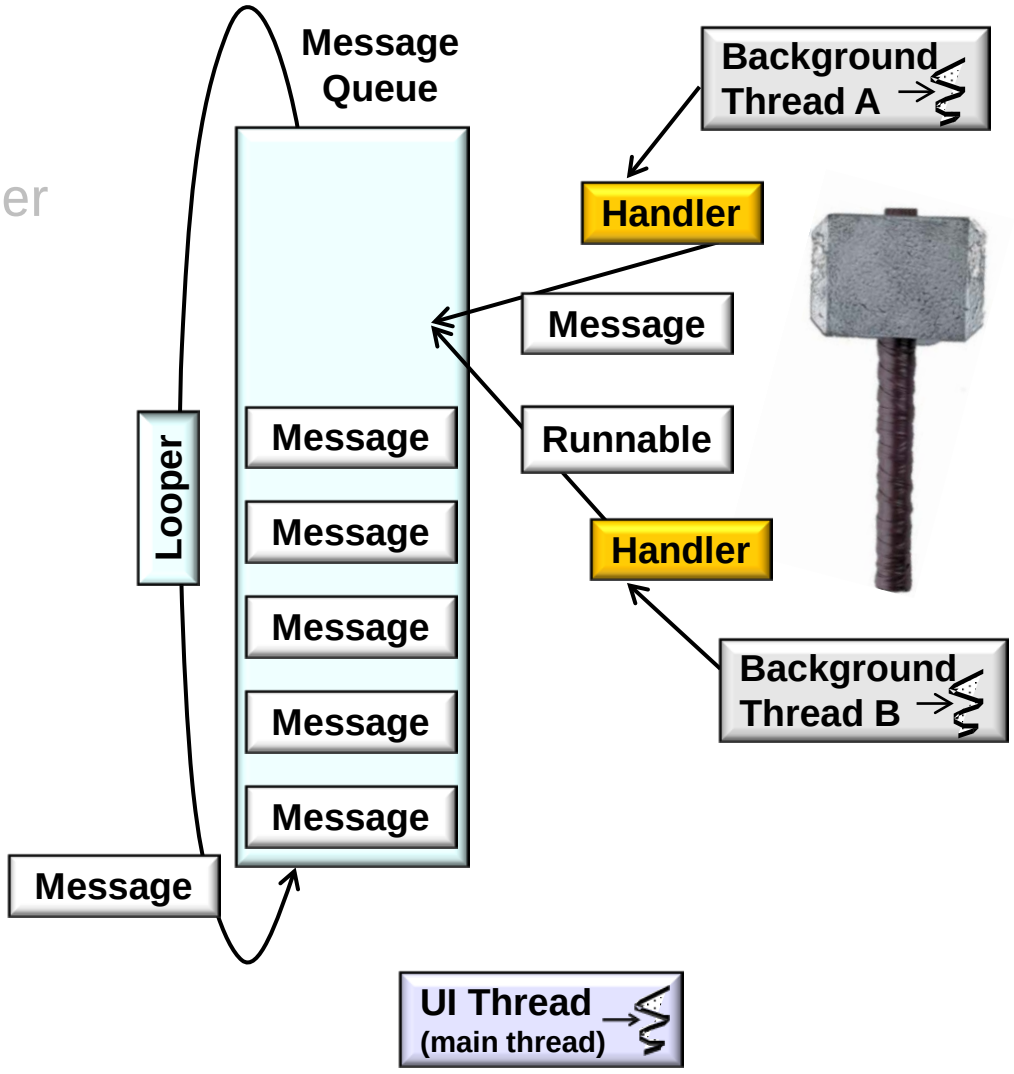
Summary

- UI & background threads often need to communicate
- HaMeR framework provides Handler class to support this use case
- post() methods used when senders know what operations to perform
- sendMethod() methods used when receivers know what operations to perform
- Handlers used in many Android applications & frameworks



Summary

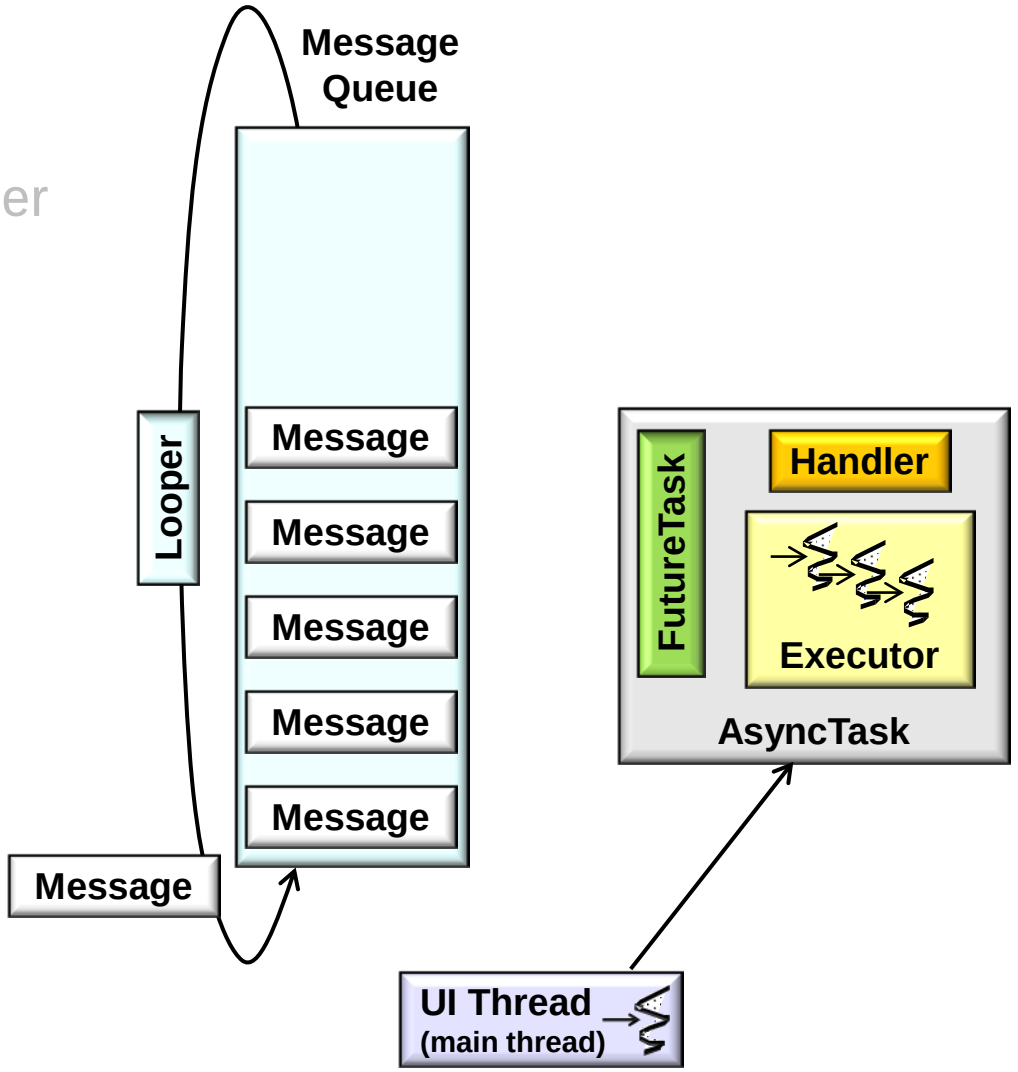
- UI & background threads often need to communicate
- HaMeR framework provides Handler class to support this use case
- post() methods used when senders know what operations to perform
- sendMethod() methods used when receivers know what operations to perform
- Handlers used in many Android applications & frameworks, e.g.
  - HaMeR framework



Next two parts focus on the HaMeR framework's use of Handlers et al

Summary

- UI & background threads often need to communicate
- HaMeR framework provides Handler class to support this use case
- post() methods used when senders know what operations to perform
- sendMethod() methods used when receivers know what operations to perform
- Handlers used in many Android applications & frameworks, e.g.
  - HaMeR framework
  - AsyncTask framework



See upcoming part on “the AsyncTask Framework”

Summary

- UI & background threads often need to communicate
- HaMeR framework provides Handler class to support this use case
- post() methods used when senders know what operations to perform
- sendMethod() methods used when receivers know what operations to perform
- Handlers used in many Android applications & frameworks
- Other sources explain how to use Handlers in Android concurrency frameworks & applications