Introduction:
Overview of Patterns & Frameworks
(Part 2)

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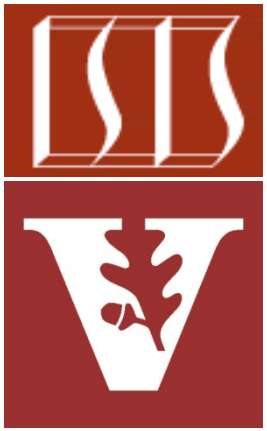

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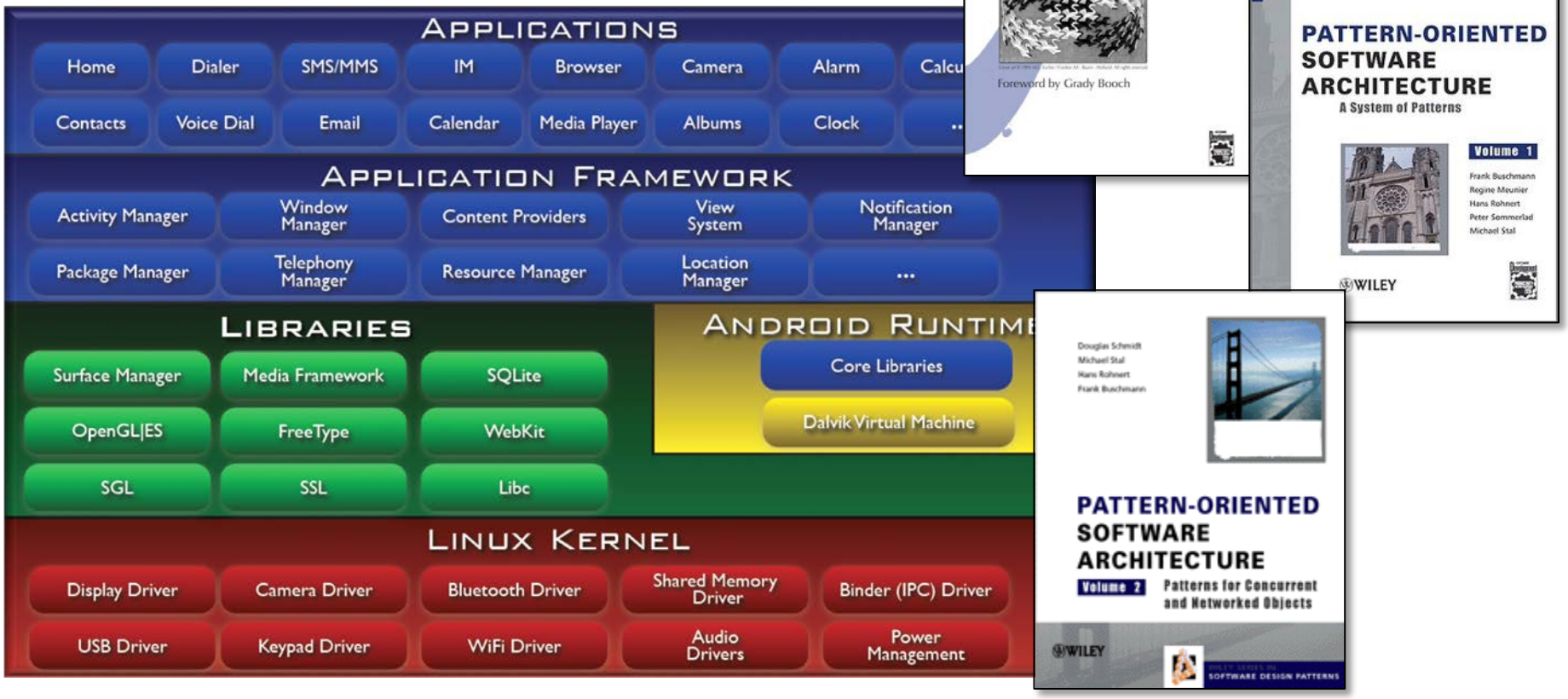
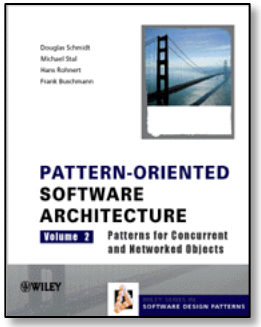
Learning Objectives in this Part of the Module

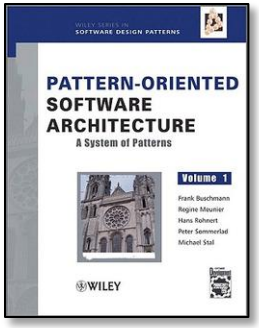
- Understand how *patterns* & *frameworks* help improve the structure & functionality of Android's concurrency & communication middleware used by Applications & Services

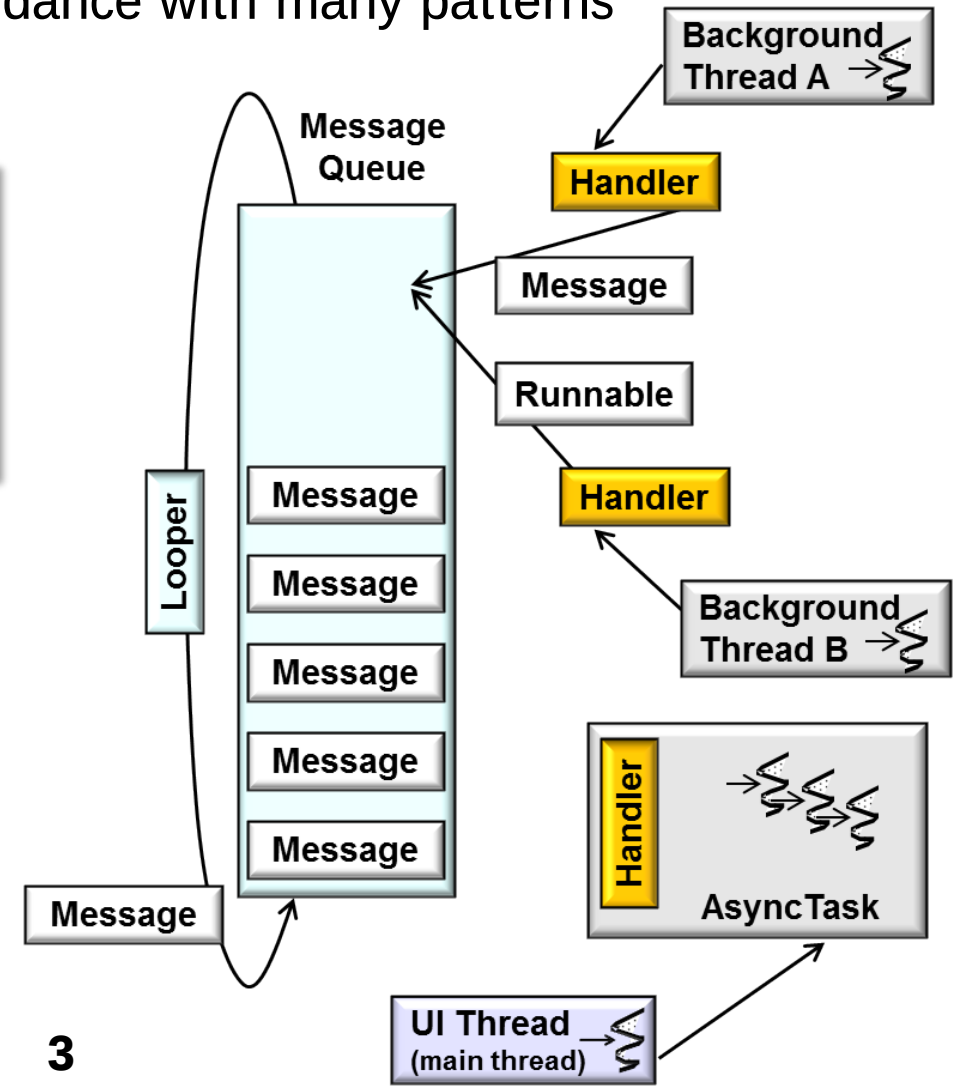


Patterns Applied in Android Frameworks

- Android's concurrency & communication frameworks are designed, implemented, & integrated in accordance with many patterns







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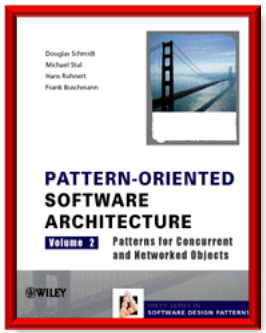
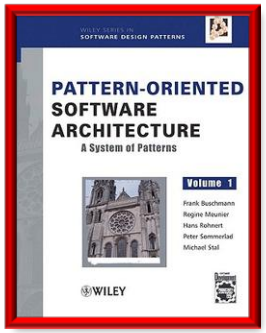
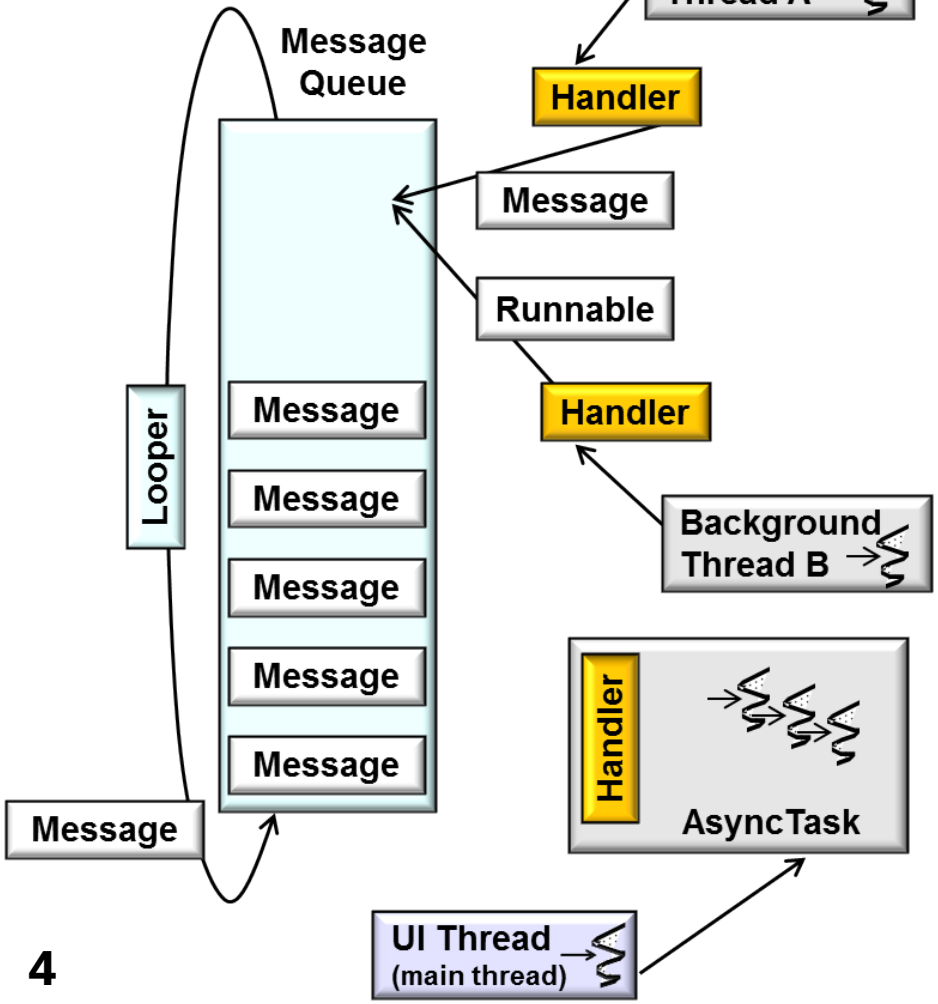
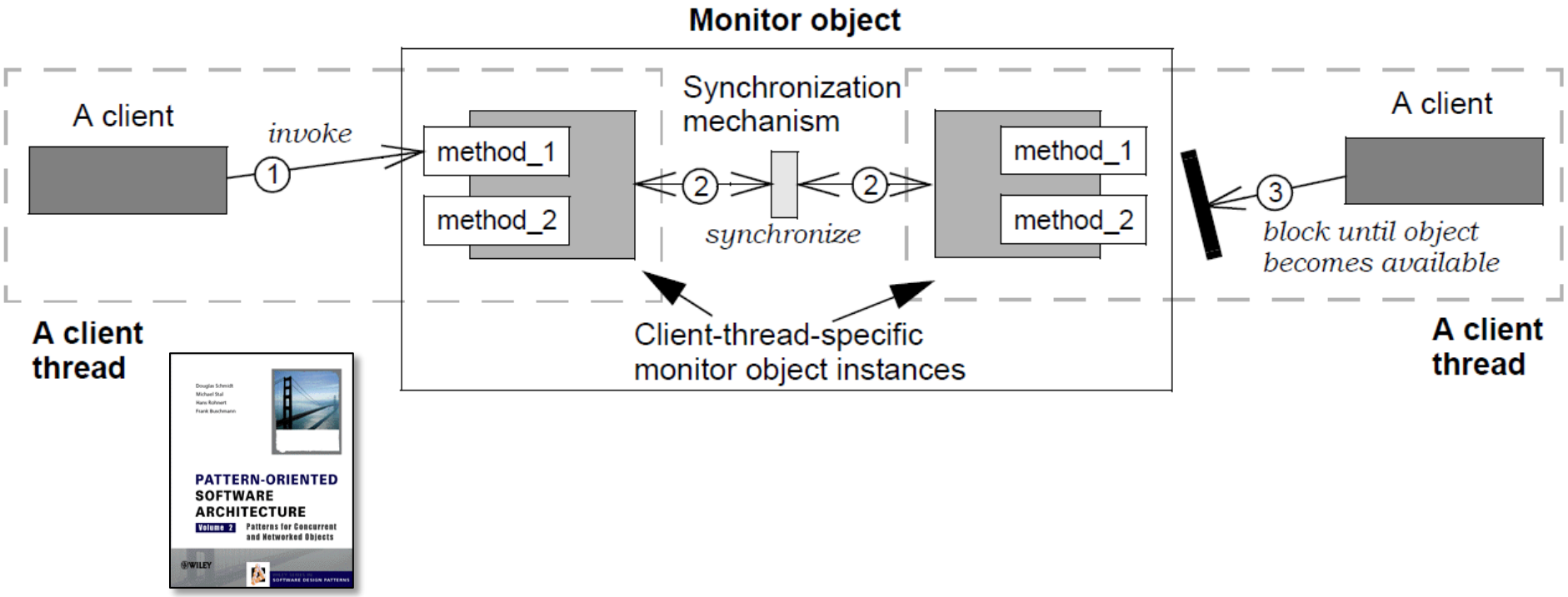






Patterns Applied in Android Frameworks

- Android's concurrency & communication frameworks are designed, implemented, & integrated in accordance with many patterns
  - *Monitor Object* – Synchronizes concurrent method execution to ensure only one method at a time runs within an object & allows an object's methods to cooperatively schedule their execution sequences



www.dre.vanderbilt.edu/~schmidt/PDF/monitor.pdf has more info

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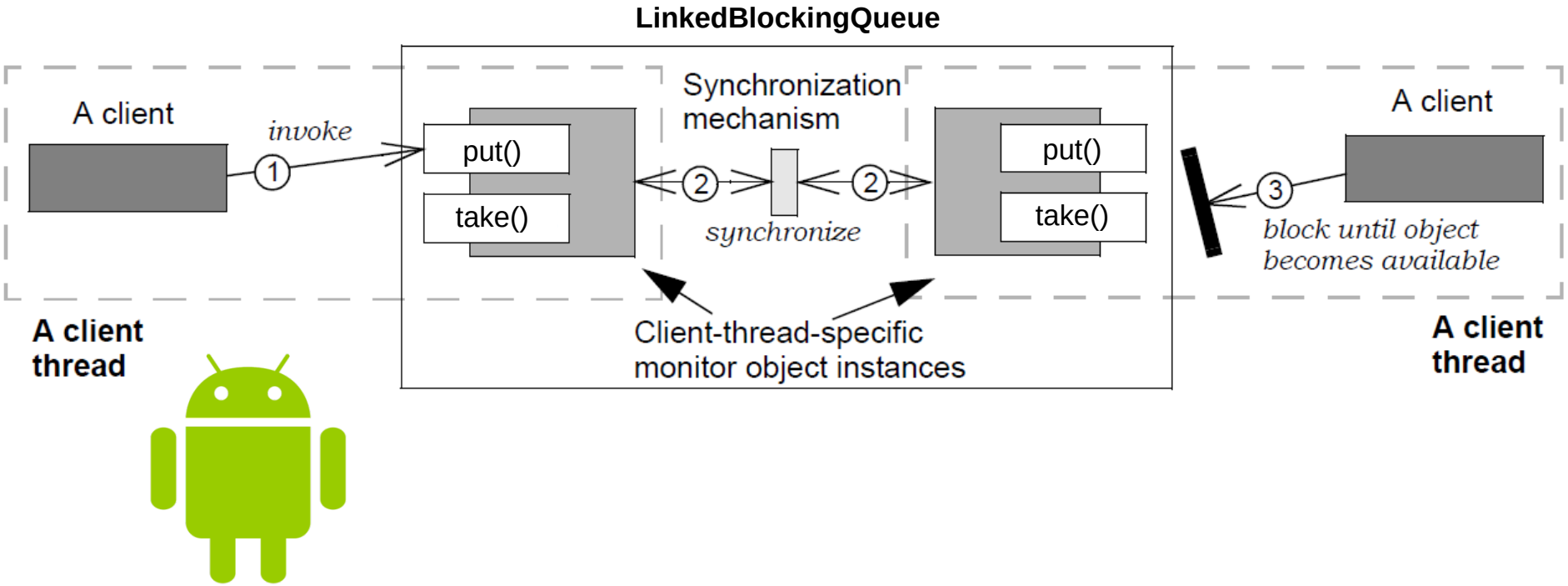
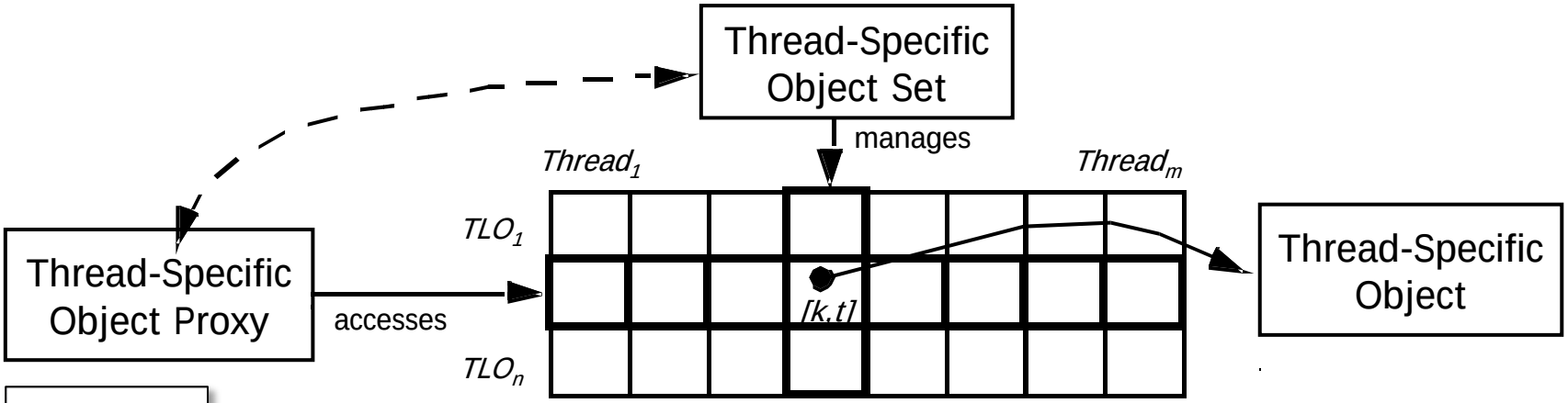
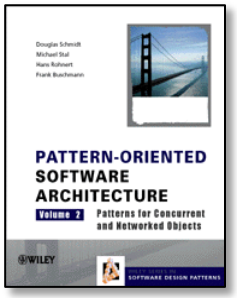


See upcoming parts on "The *Monitor Object* Pattern"

Patterns Applied in Android Frameworks

- Android's concurrency & communication frameworks are designed, implemented, & integrated in accordance with many patterns
  - *Thread-Specific Storage* – allows multiple threads to use one 'logically global' access point to retrieve an object that is local to a thread, without incurring locking overhead on each object access





www.dre.vanderbilt.edu/~schmidt/PDF/TSS-pattern.pdf has more info

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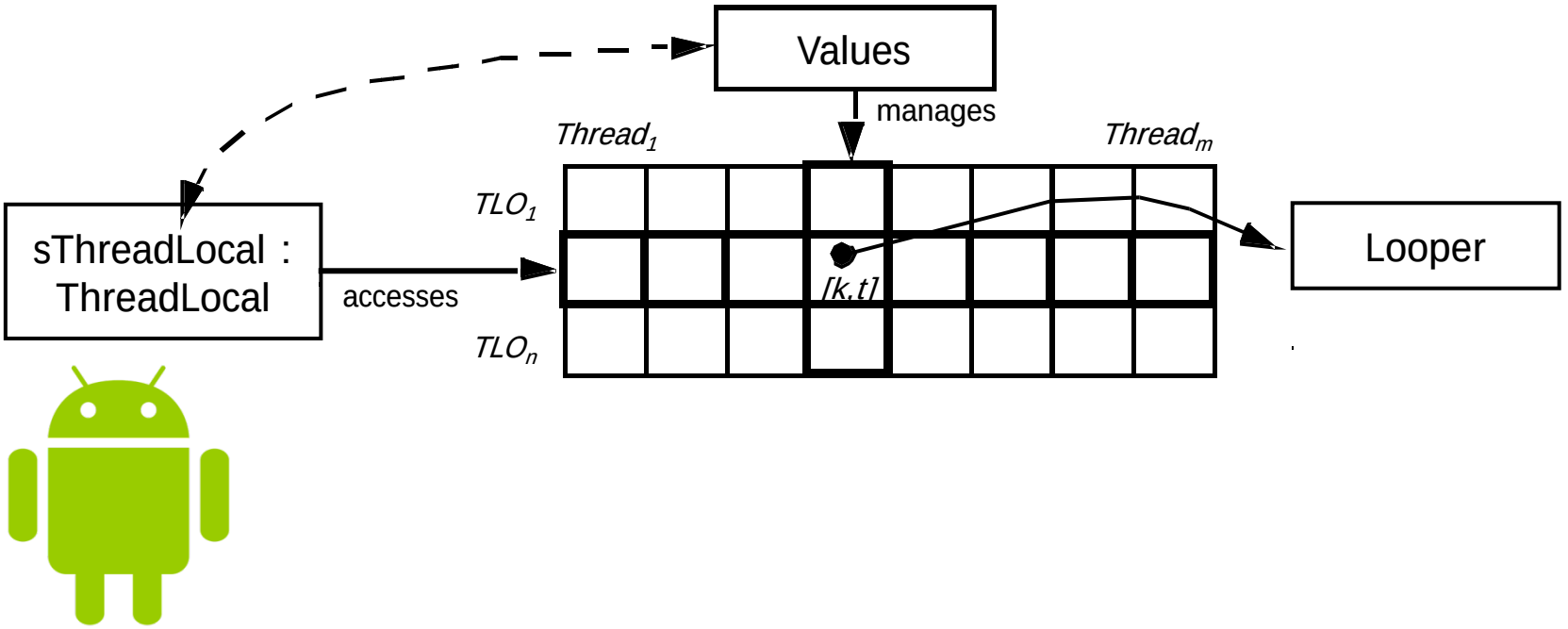
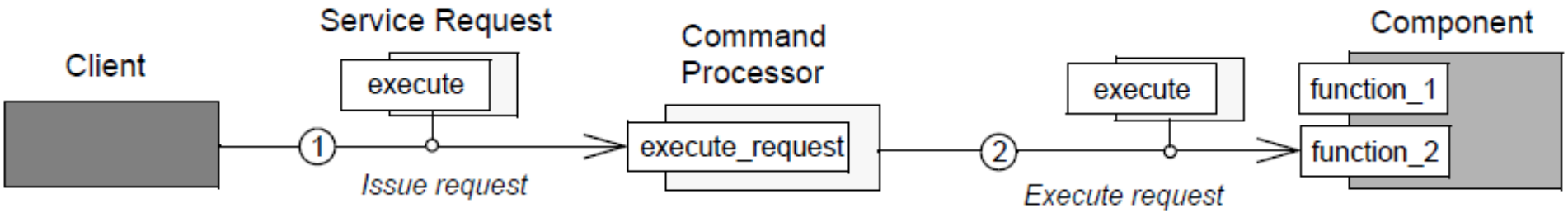
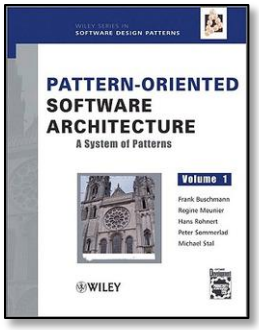


See upcoming parts on "The *Thread-Specific Storage* Pattern"

Patterns In Android Concurrency Frameworks

- Android's concurrency & communication frameworks are designed, implemented, & integrated in accordance with many patterns
  - *Command Processor* – package a piece of application functionality—as well as its parameterization in an object—to execute it in another context
    - e.g., at a later point in time, in a different process or thread, etc.





www.dre.vanderbilt.edu/~schmidt/PDF/CommandRevisited.pdf has more info

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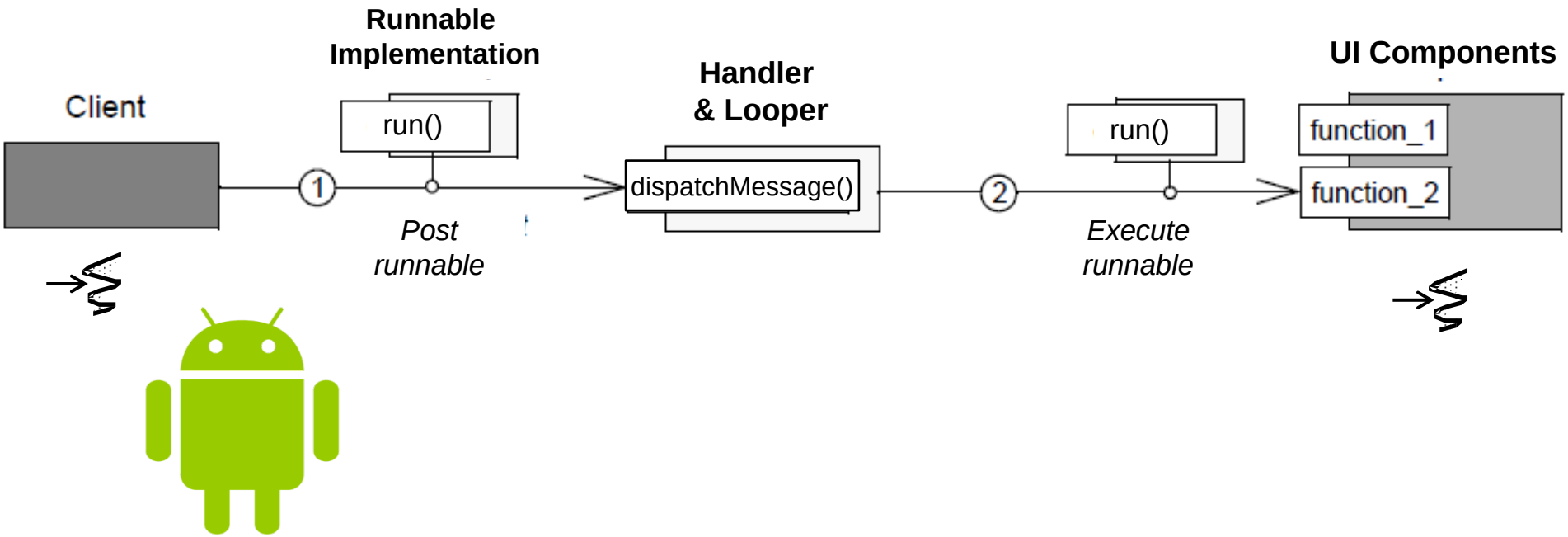

See upcoming parts on the "Android Handler"

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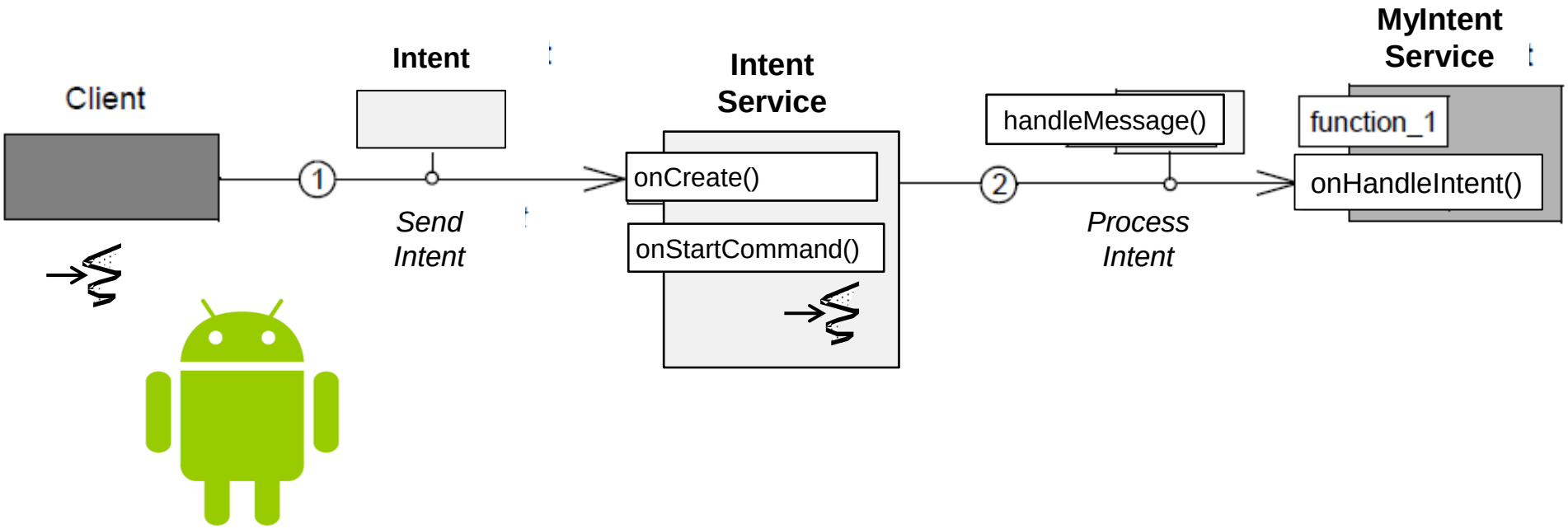
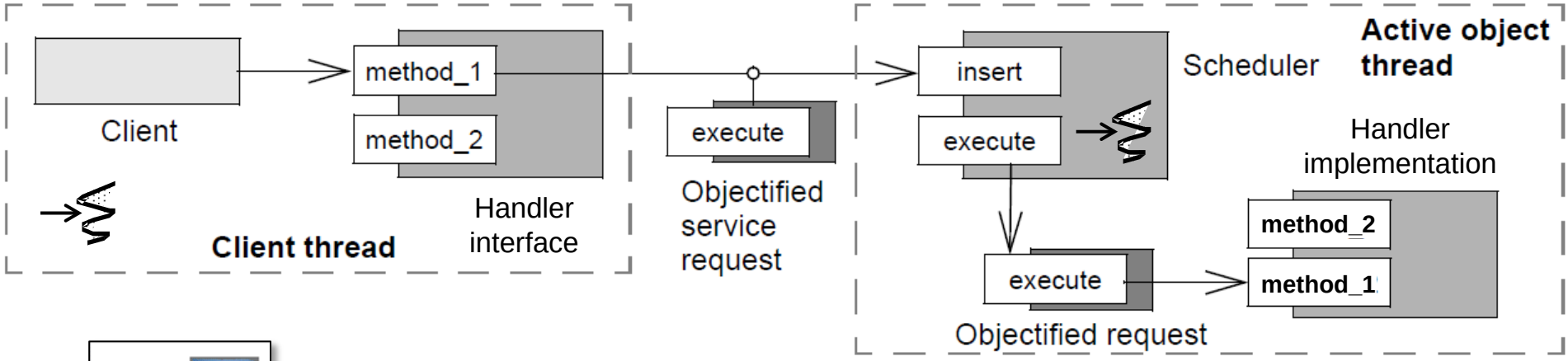


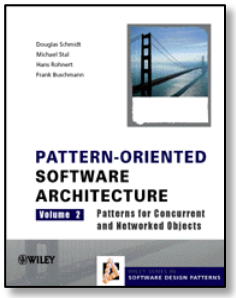
See upcoming part on the "Activity & Service Communication"

POSA Patterns in Android Concurrency Frameworks

Patterns In Android Concurrency Frameworks

- Android's concurrency & communication frameworks are designed, implemented, & integrated in accordance with many patterns
  - *Active Object* – define service requests on components as the units of concurrency & run service requests on a component in different thread(s) from the requesting client thread





www.dre.vanderbilt.edu/~schmidt/PDF/Act-Obj.pdf has more info

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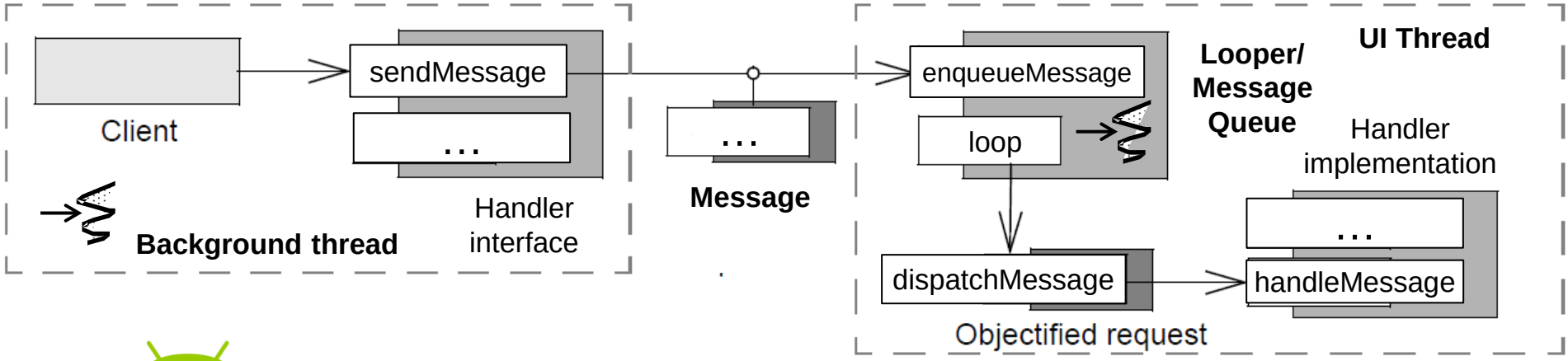

See upcoming parts on "The *Active Object* Pattern"

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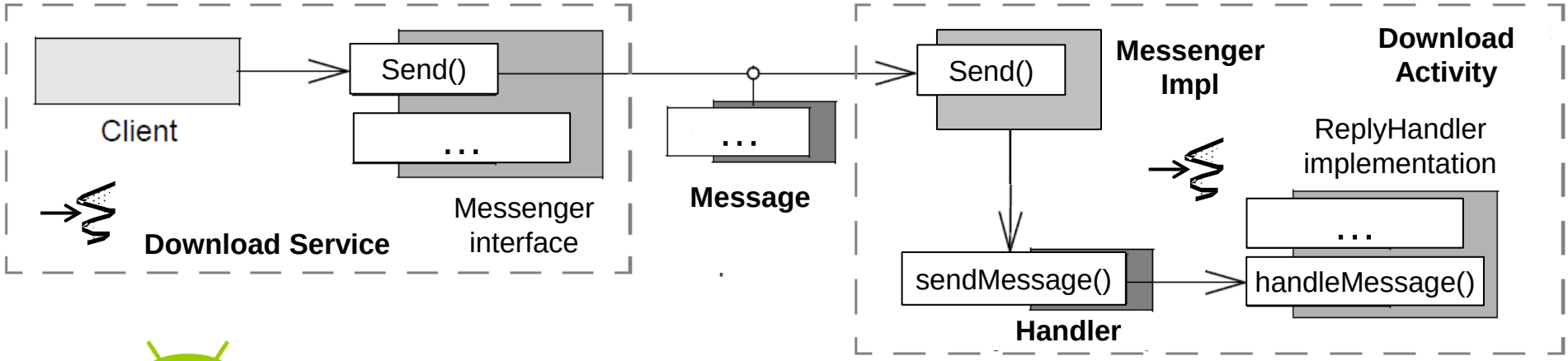
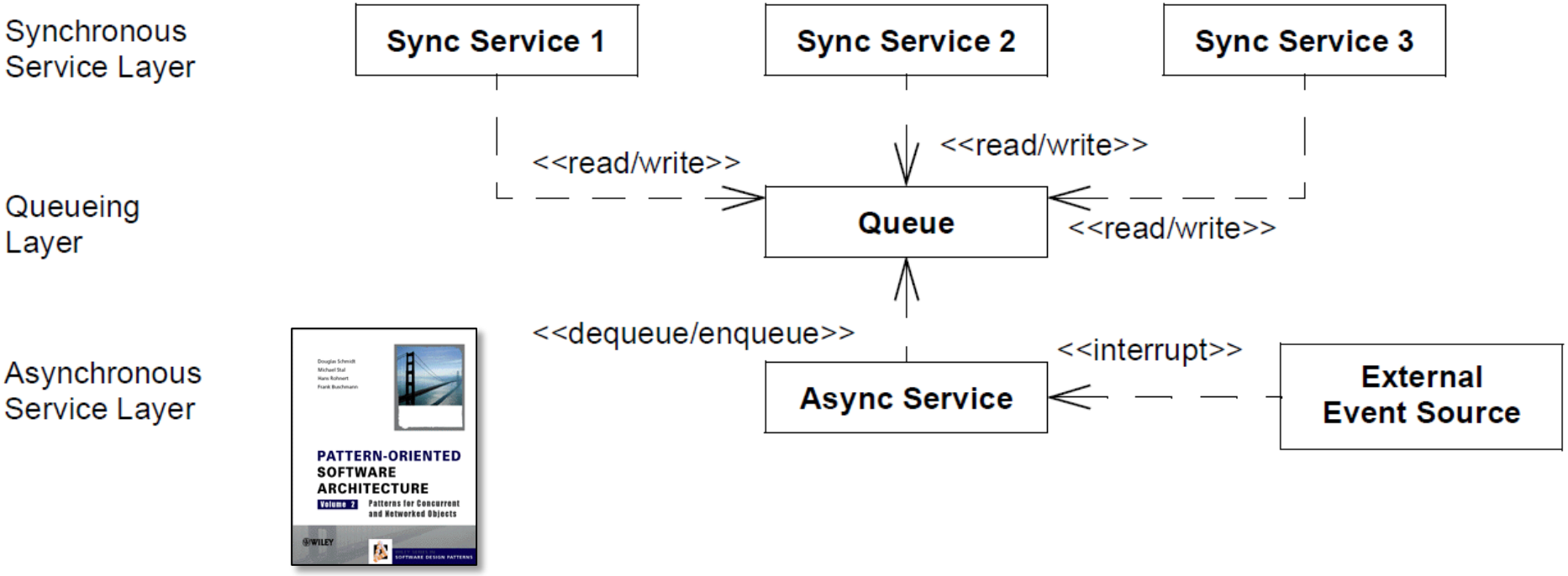


See upcoming part on "Activity & Service Communication"

Patterns In Android Concurrency Frameworks

- Android's concurrency & communication frameworks are designed, implemented, & integrated in accordance with many patterns
  - *Half-Sync/Half-Async* – Decouple async & sync service processing in concurrent systems by introducing two intercommunicating layers to simplify programming without unduly reducing performance



www.dre.vanderbilt.edu/~schmidt/PDF/HS-HA.pdf has more info

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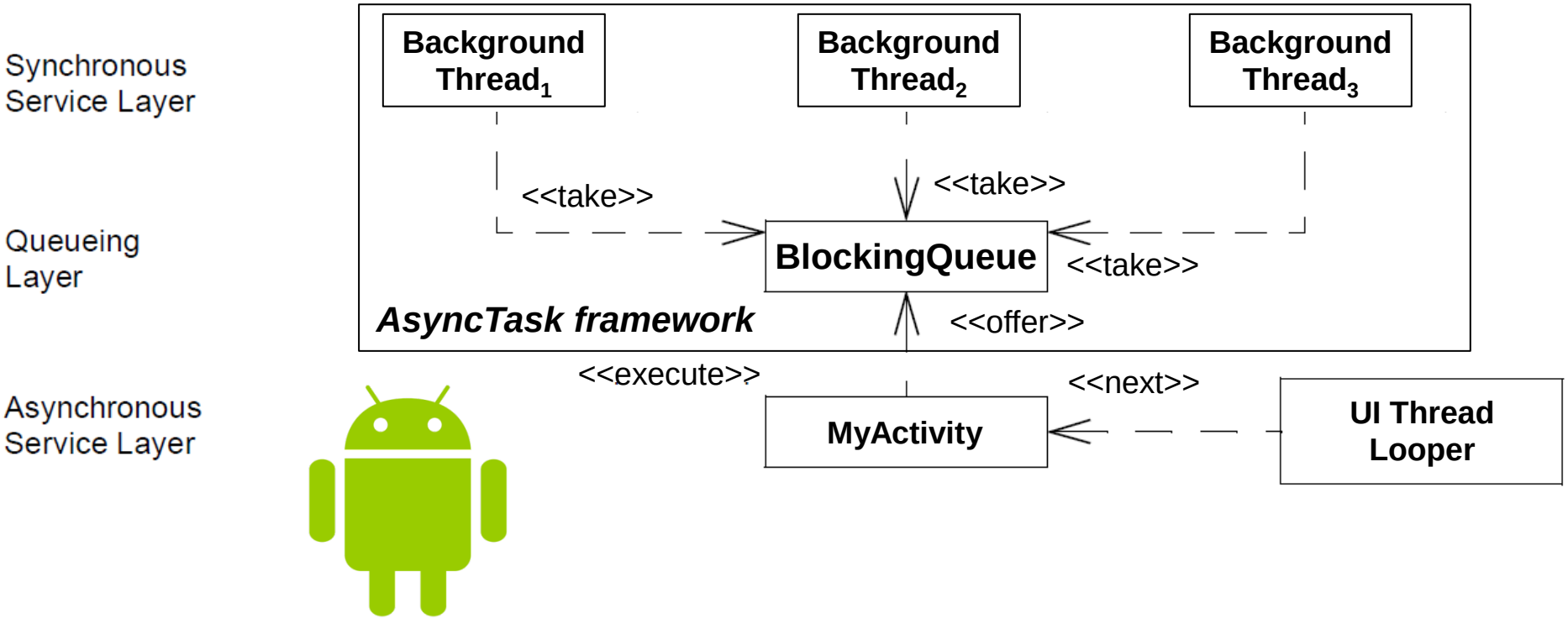
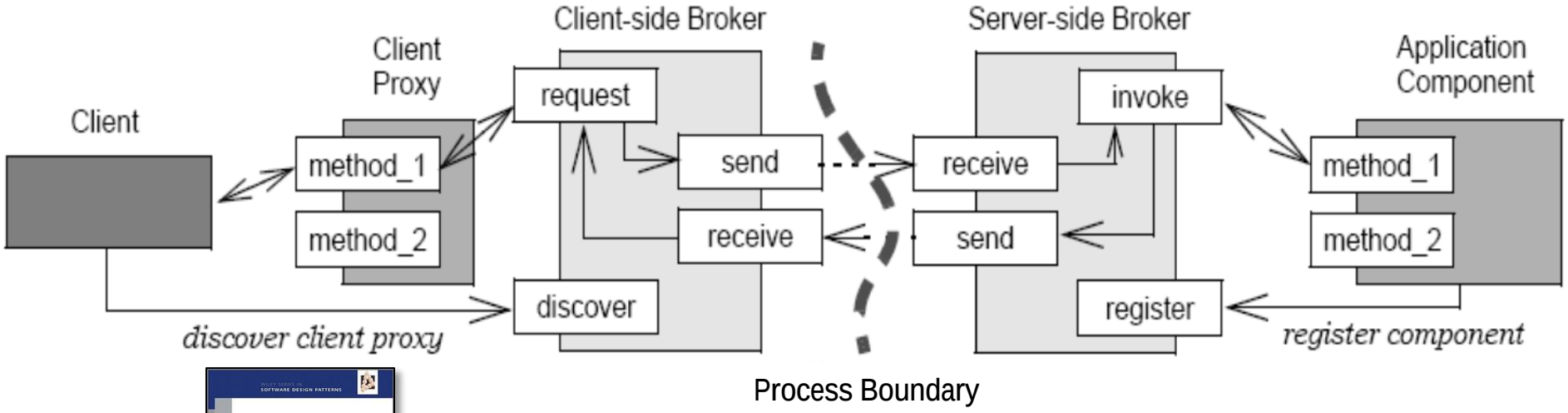
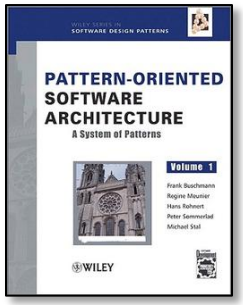


See upcoming parts on "The *Half-Sync/Half-Async* Pattern"

Patterns In Android Concurrency Frameworks

- Android's concurrency & communication frameworks are designed, implemented, & integrated in accordance with many patterns
  - *Broker* – Connect clients with remote objects by mediating invocations from clients to remote objects, while encapsulating the details of local and/or remote inter-process communication (IPC)





www.kircher-schwanninger.de/michael/publications/BrokerRevisited.pdf

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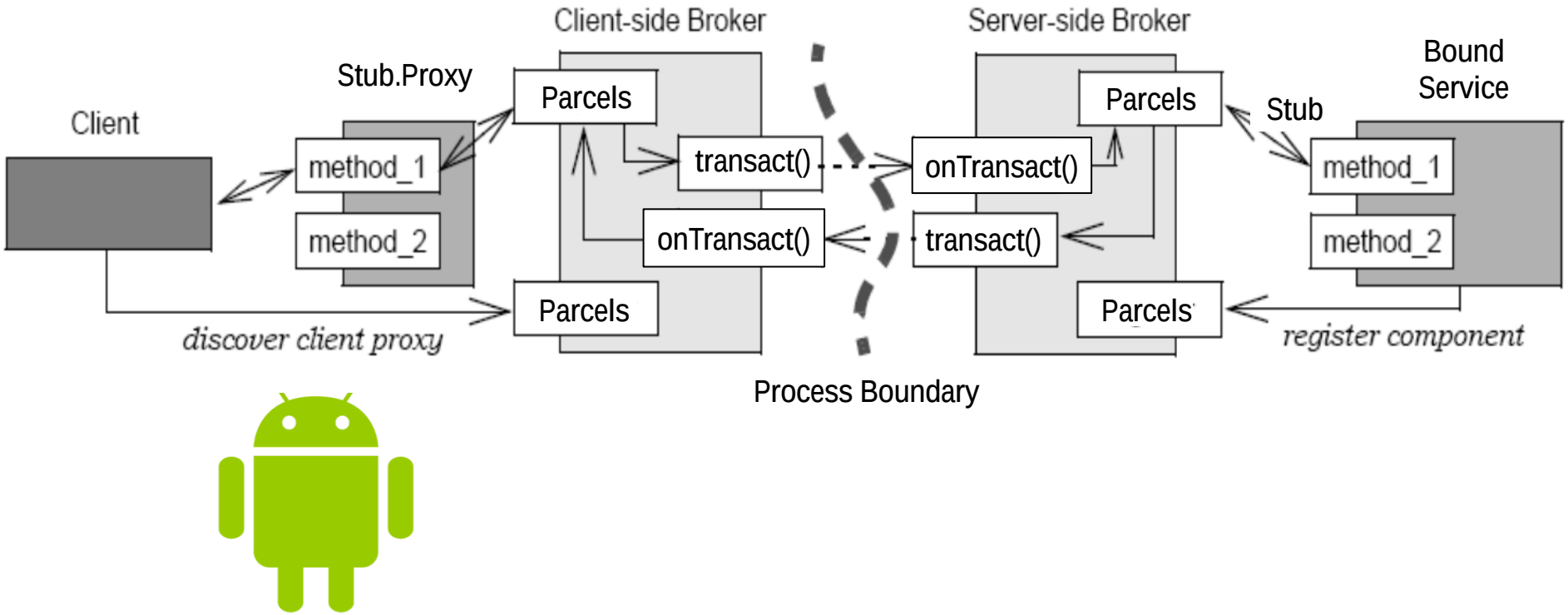

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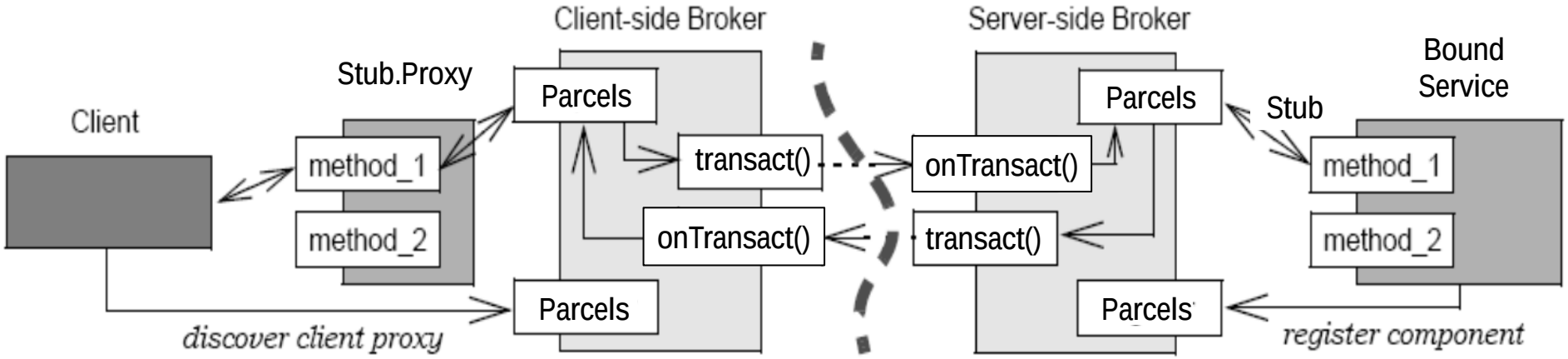

www.dre.vanderbilt.edu/~schmidt/POSA has more on *Broker* pattern language

Gang-of-Four Patterns in Android Concurrency Frameworks

Patterns In Android Concurrency Frameworks

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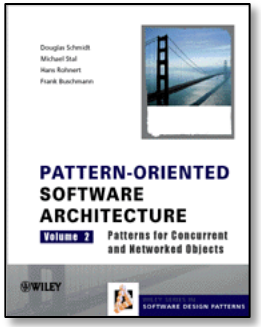

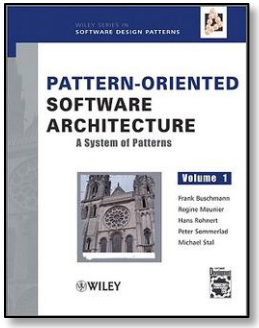

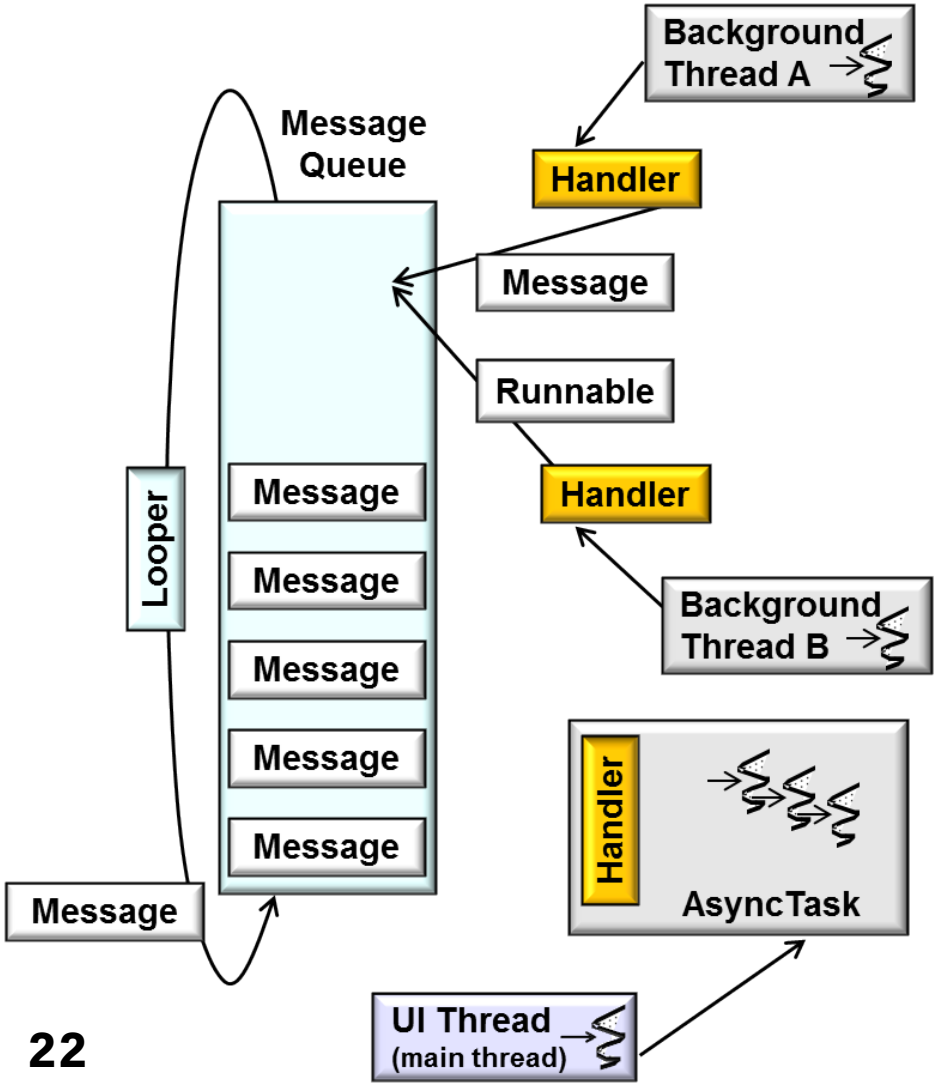

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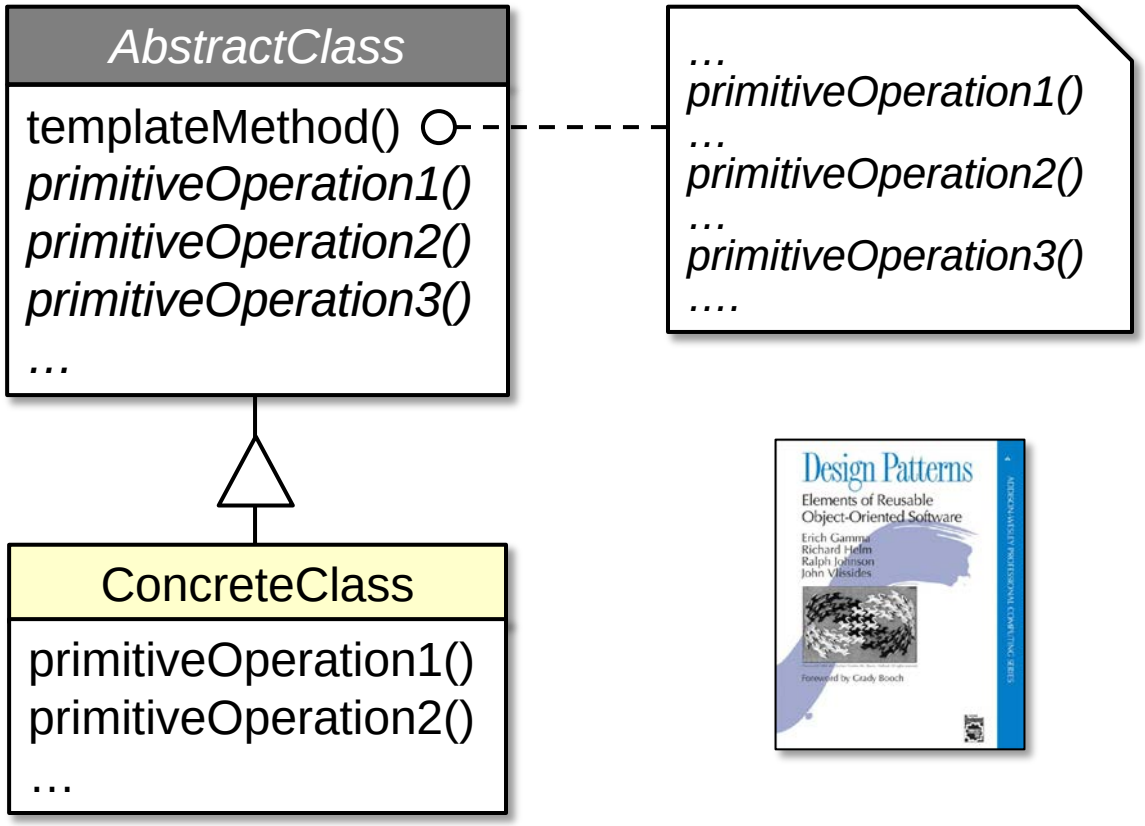

en.wikipedia.org/wiki/Template_method_pattern has more info

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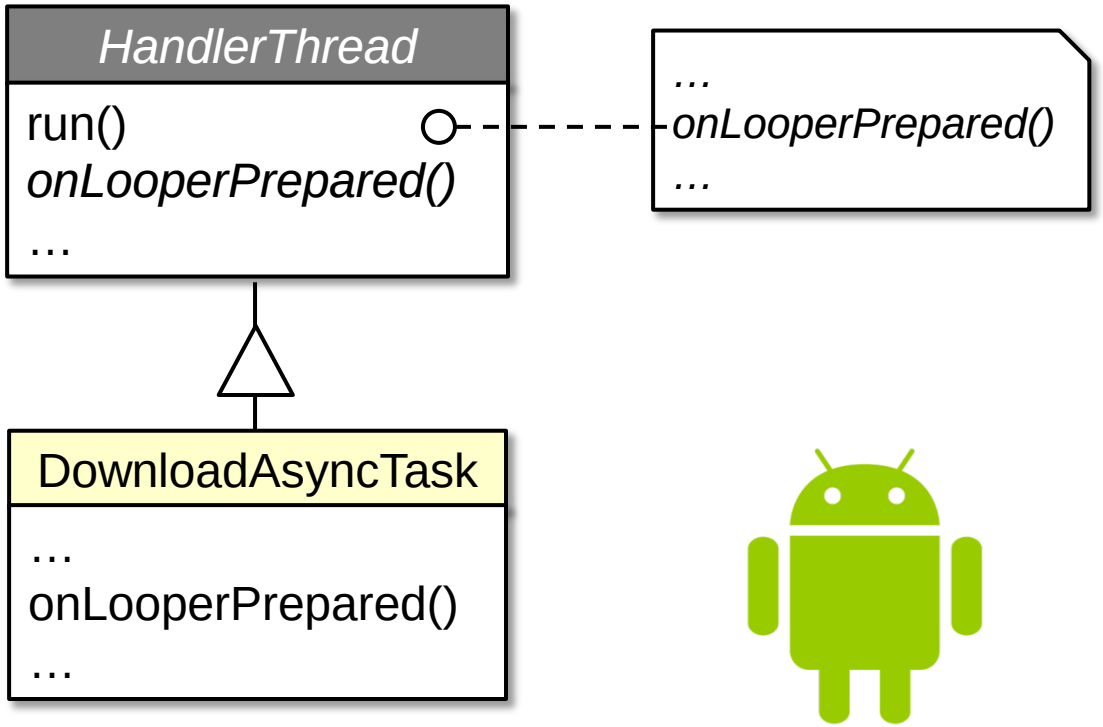

Patterns In Android Concurrency Frameworks

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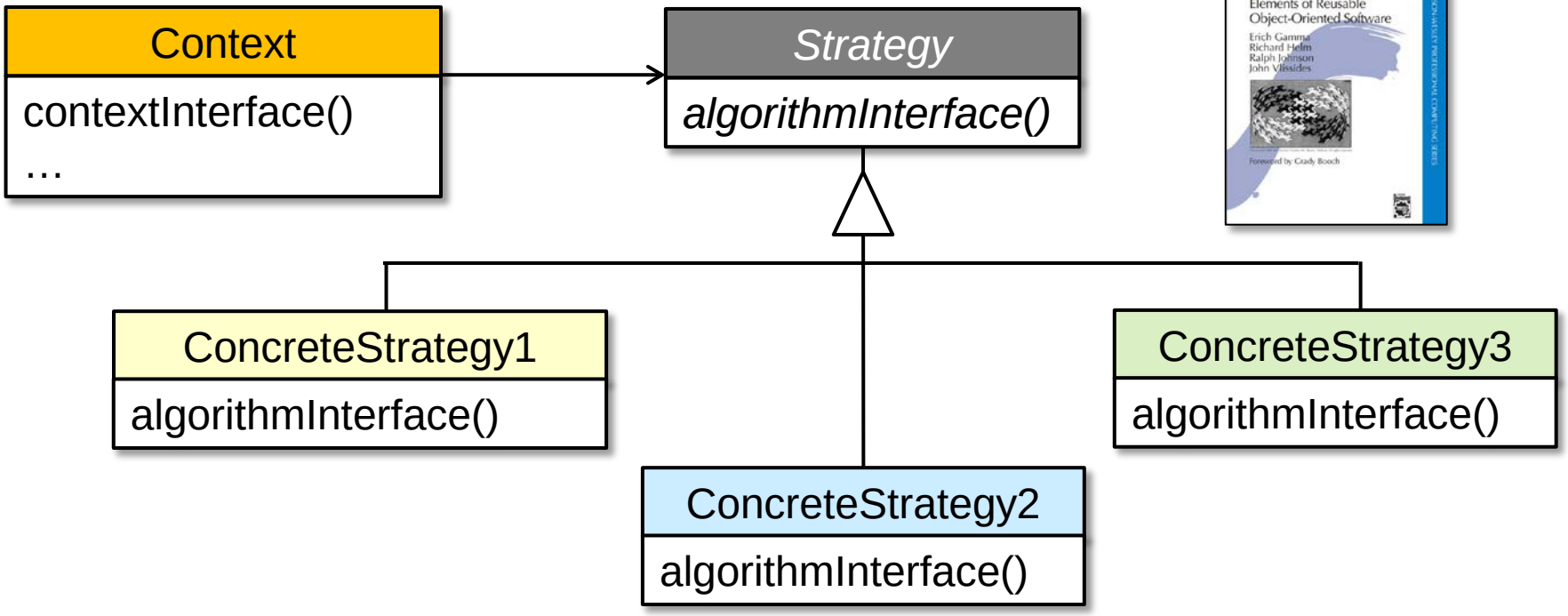
  - *Strategy* – define a family of algorithms, encapsulate each one, & make them interchangeable to let clients & algorithms vary independently



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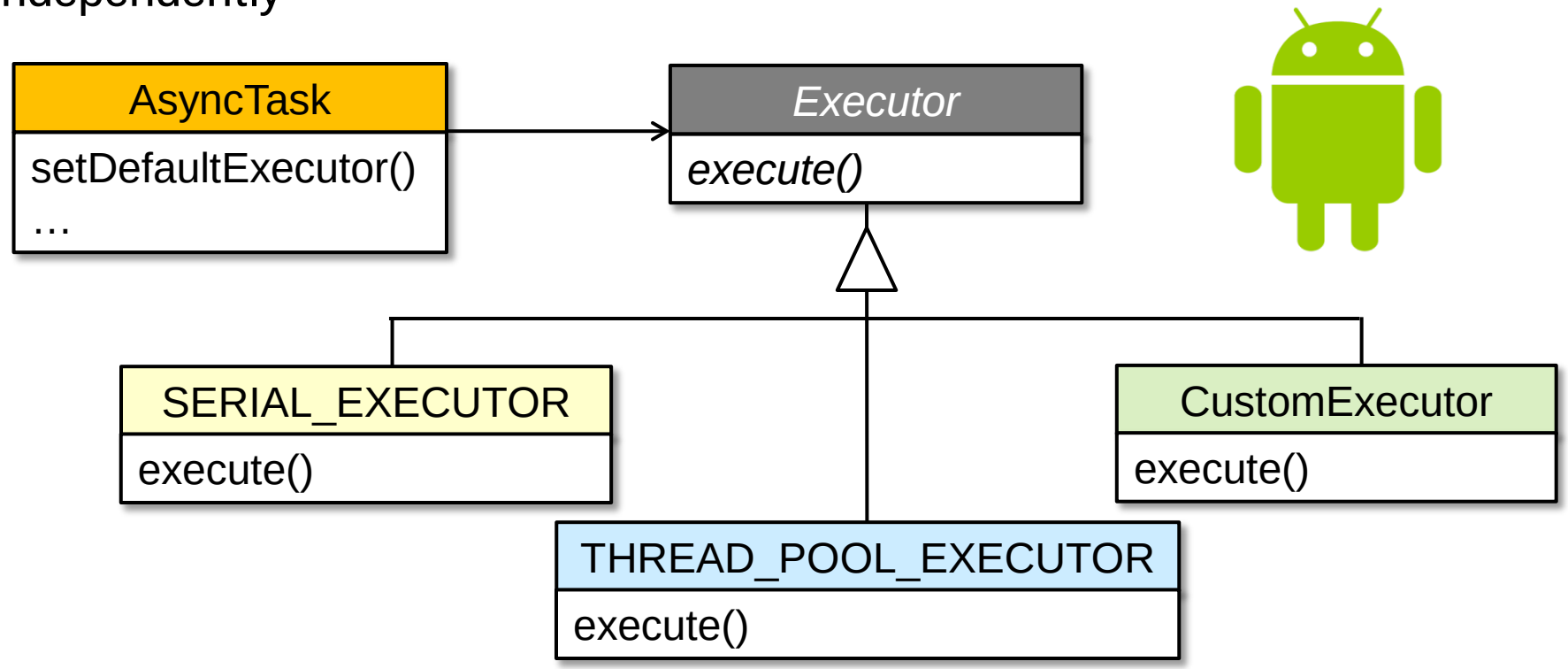

See upcoming part on the "AsyncTask Framework"

Patterns In Android Concurrency Frameworks

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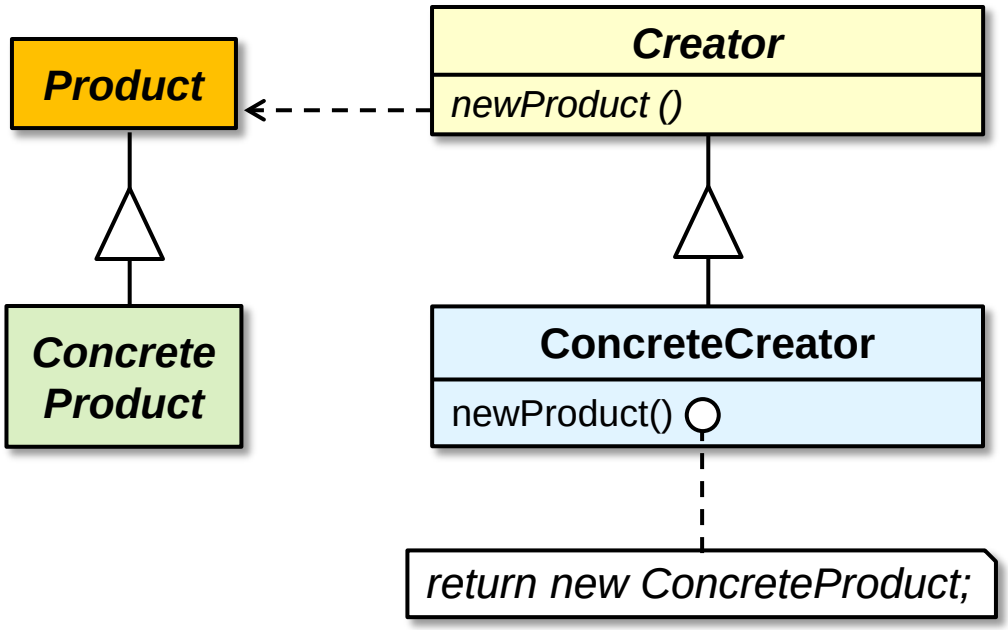
  - *Factory Method* – provide an interface for creating an object, but leaving the choice of the object's concrete type to a subclass



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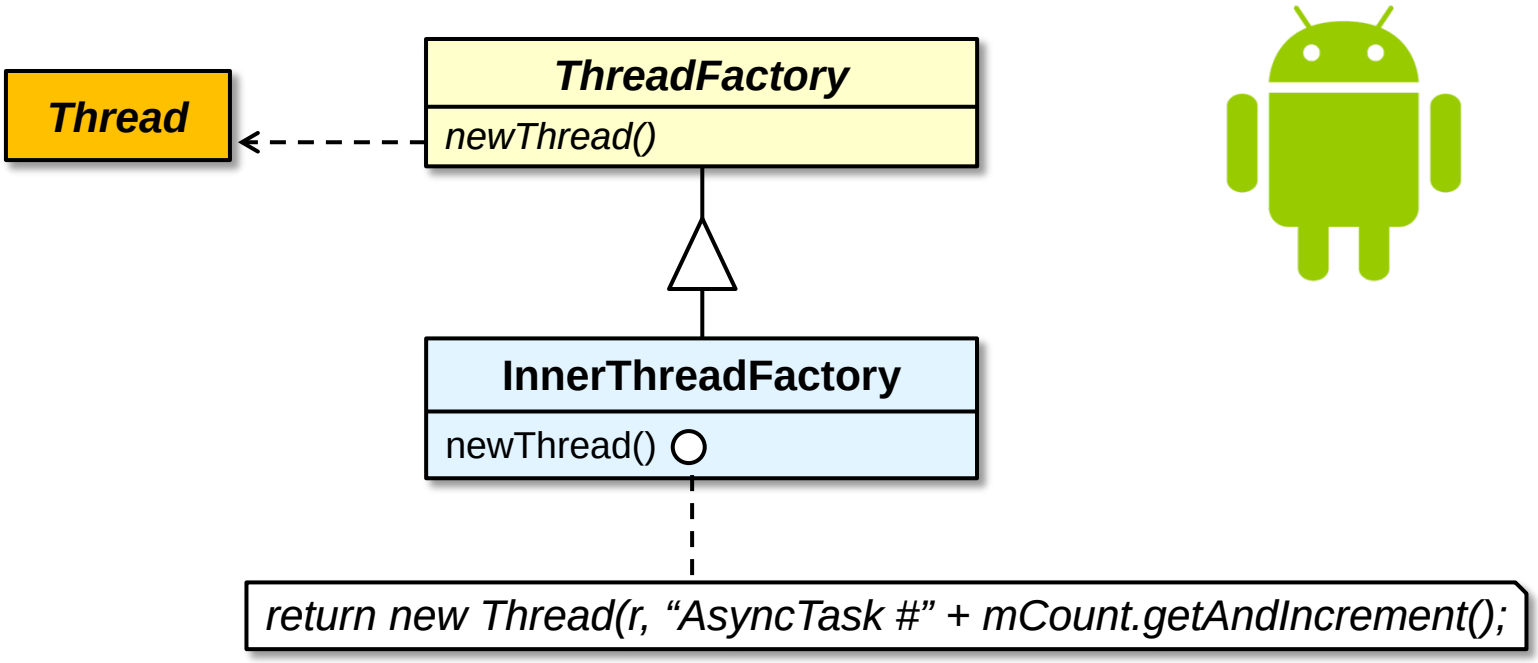


See upcoming parts on "The *Half-Sync/Half-Async* Pattern"

Patterns In Android Concurrency Frameworks

- Android's concurrency frameworks are designed, implemented, & integrated in accordance with many patterns
  - Java concurrency mechanisms are used in Android's concurrent frameworks

package **Added in API level 1**

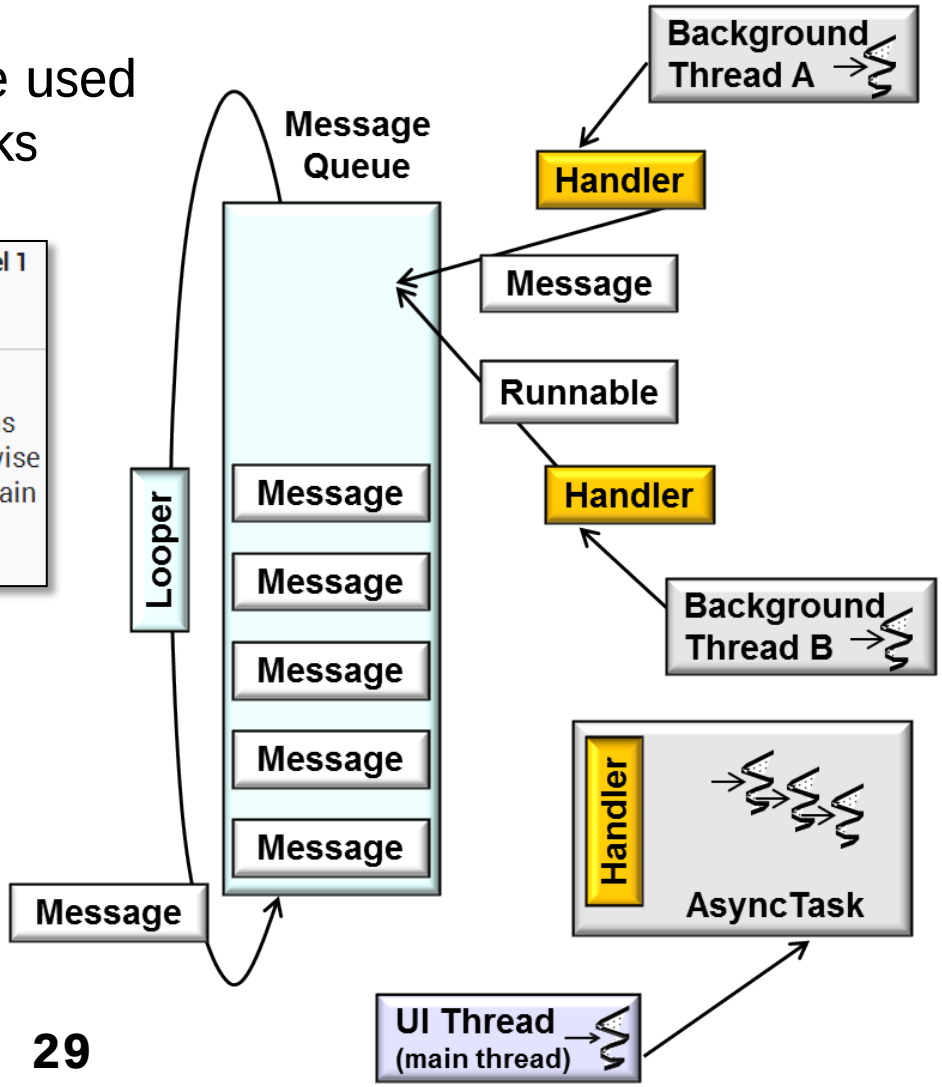
java.util.concurrent

Utility classes commonly useful in concurrent programming. This package includes a few small standardized extensible frameworks, as well as some classes that provide useful functionality and are otherwise tedious or difficult to implement. Here are brief descriptions of the main components. See also the `java.util.concurrent.locks` and `java.util.concurrent.atomic` packages.

package **Added in API level 1**

java.util.concurrent.locks

Interfaces and classes providing a framework for locking and waiting for conditions that is distinct from built-in synchronization and monitors. The framework permits much greater flexibility in the use of locks and conditions, at the expense of more awkward syntax.
The `Lock` interface supports locking disciplines that differ in semantics (reentrant, fair, etc), and that can be used in non-block-structured contexts including hand-over-hand and lock reordering algorithms. The main implementation is `ReentrantLock`.



Patterns In Android Concurrency Frameworks

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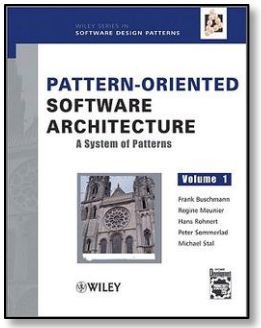
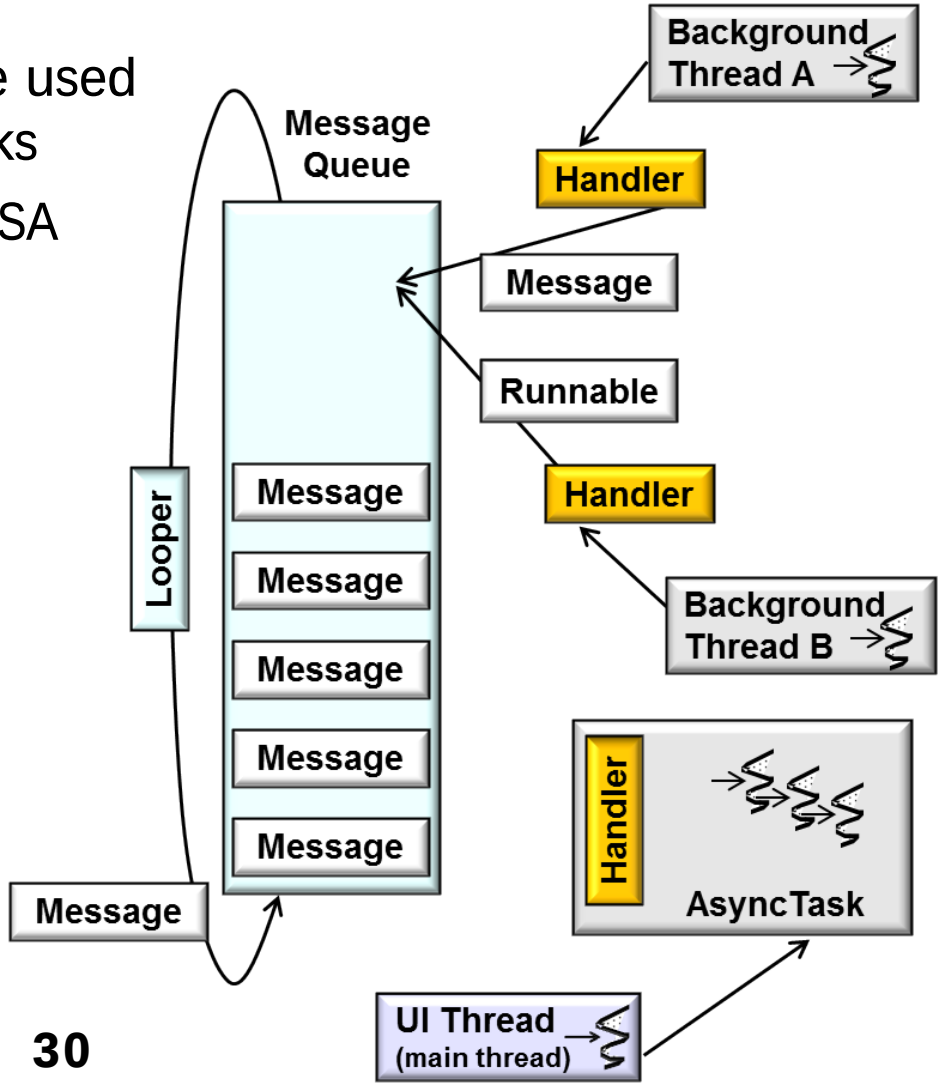
  - Java concurrency mechanisms are used in Android's concurrent frameworks
  - We'll also discuss other GoF & POSA patterns throughout this section





Summary

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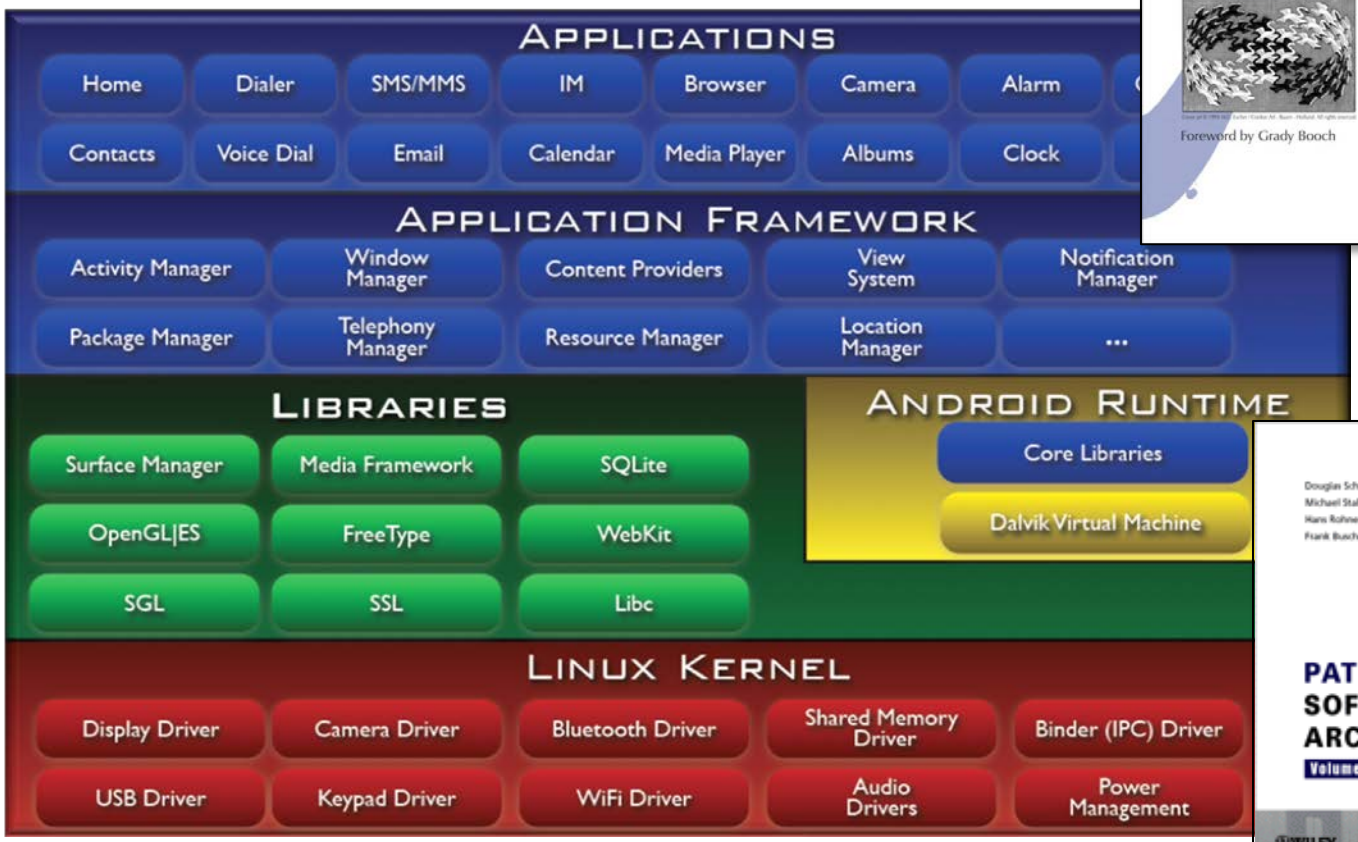
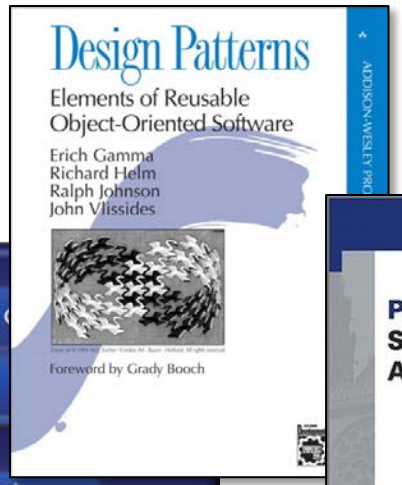
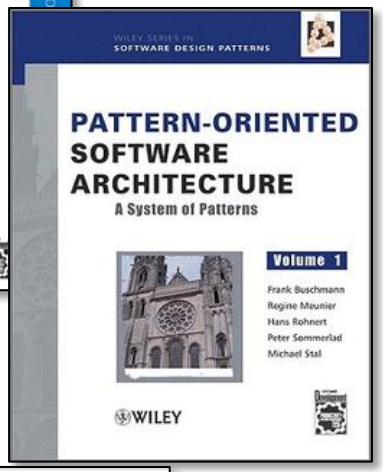
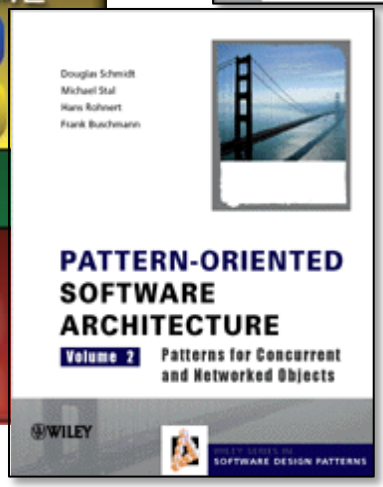
- Android applies *patterns* & *frameworks* to help improve its structure & functionality



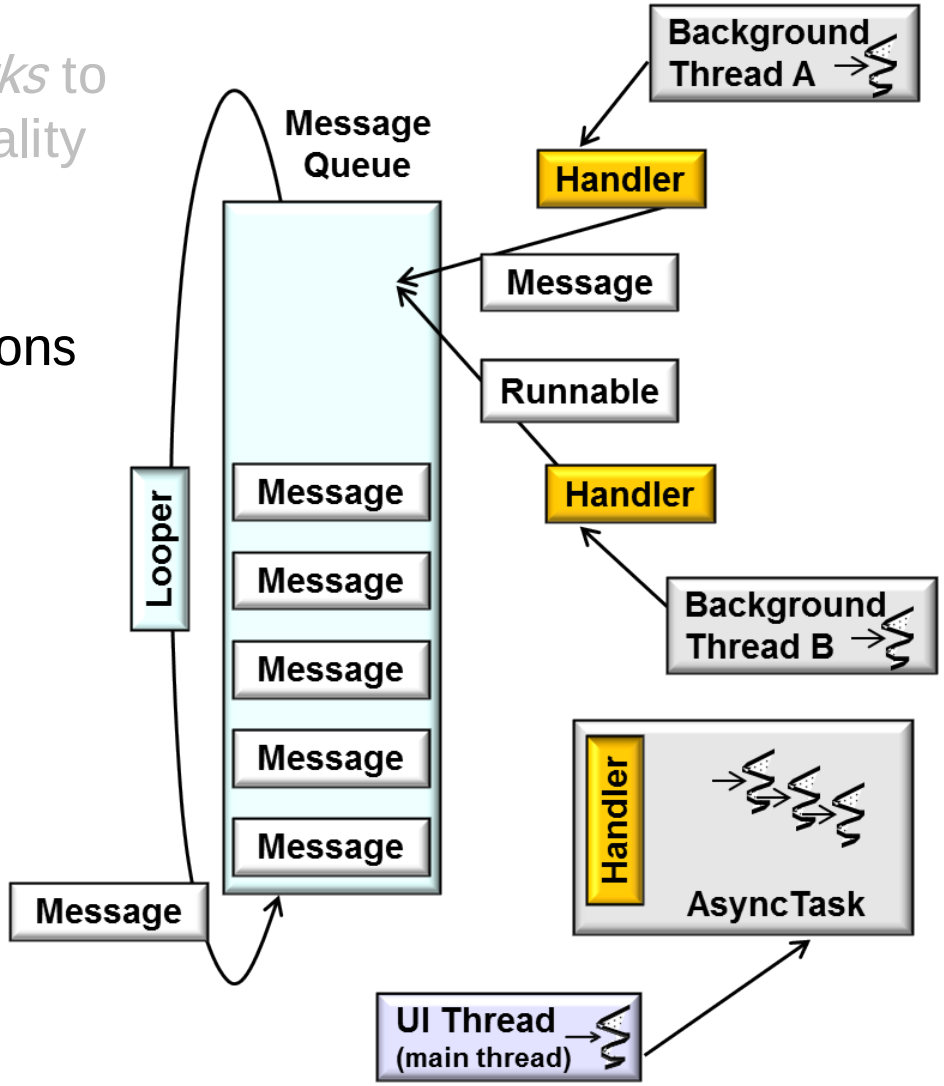






Summary

- Android applies *patterns* & *frameworks* to help improve its structure & functionality
- Patterns & frameworks codify "best practices" of design & architecture in systematically reusable implementations



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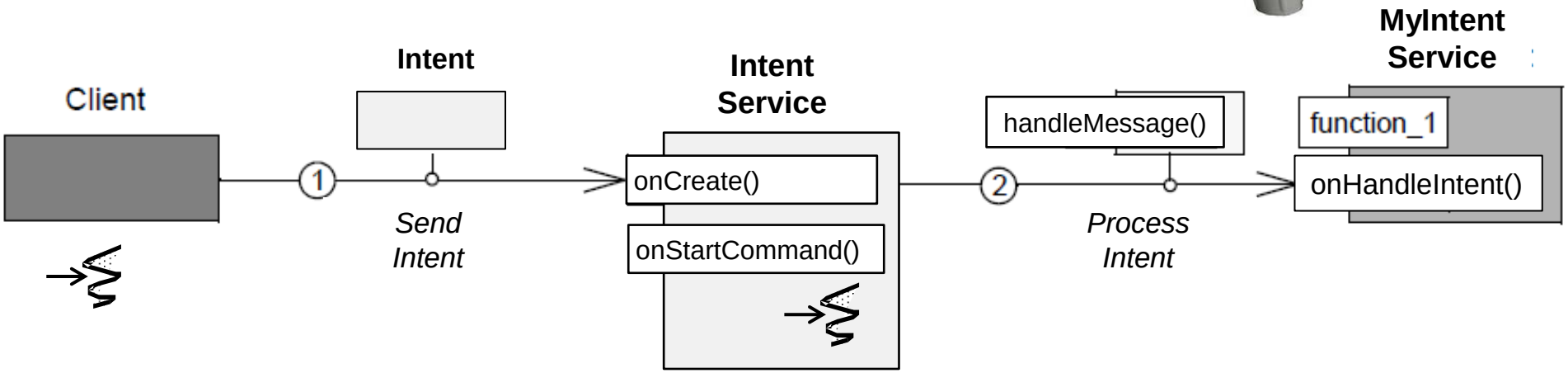

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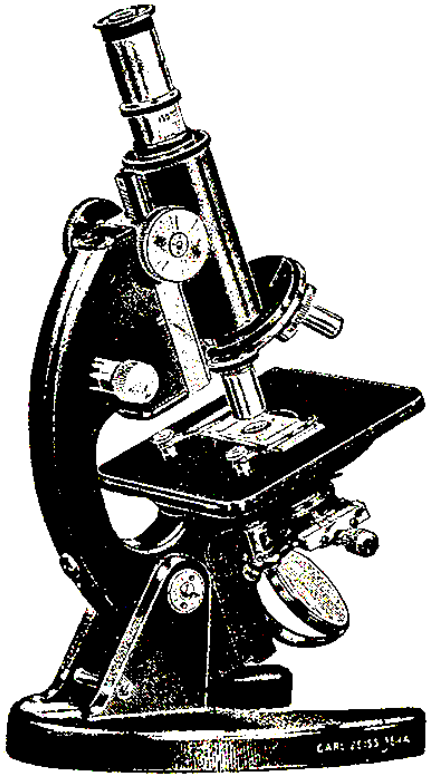

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- Since it's available as open-source it's an ideal environment for learning about—& experimenting with—powerful forms of systematic reuse

See class.coursera.org/posa-002/wiki/Source_Code_By_Week