

With Use Cases, Explanations, and Code Examples

Protocols powering SwiftUI internals

- ✓ Sendable
- ✓ ViewBuilder
- ✓ Actor
- ✓ MainActor
- √ AsyncIteratorProtocol
- √ AsyncSequence
- ✓ ResultBuilder

- ✓ Sequence and Collection
- ✓ Error (Custom Error Types)
- ✓ Layout (SwiftUI 2023+)

Sendable

Explanation:

Ensures a value can be safely passed across concurrency domains (e.g., to another task or thread).

Example:

```
struct User: Sendable {
  let id: Int
}
```

We Case:

Required for data passed between structured concurrency units like tasks and actors.

ViewBuilder

Explanation:

Special result builder used by SwiftUI to compose views declaratively.

Example:

```
@ViewBuilder
func buildSection(show: Bool) -> some View {
    if show {
        Text("Visible")
    } else {
        EmptyView()
    }
}
```

We Case:

Create custom view factories or reusable UI components with branching logic.

Actor

Explanation:

A reference type that protects its mutable state using isolation from concurrency issues. Protects from data races by allowing only one task at a time to access its internal properties.

Example:

```
actor Counter {
    private var count = 0

func increment() {
    count += 1
    }
}
```

Service Use Case:

Used to isolate and protect shared mutable state in concurrent environments, like caching, session management, or file access.

MainActor

Explanation:

Used to isolate a class or function to run on the main thread.

Example:

```
@MainActor
class ViewModel {
    var title: String = ""
    func updateUI() {
        // always runs on main thread
    }
}
```

Service Use Case:

Protect UI state changes or any main-thread-only logic. @MainActor can be applied to functions, classes, or properties.

AsynclteratorProtocol

Explanation:

Provides the logic to fetch each async value inside an AsyncSequence.

Example:

```
struct Countdown: AsynclteratorProtocol {
  var current = 3
  mutating func next() async -> Int? {
    guard current > 0 else { return nil }
    defer { current -= 1 }
    return current
Used by:
AsyncSequence.makeAsyncIterator()
→ returns this type to power the loop
```



Emit values one by one — like countdowns or delayed actions

AsyncSequence

Explanation:

A protocol for types that emit values over time, used with for await.

Example:

```
struct Counter: AsyncSequence {
  typealias Element = Int
  func makeAsyncIterator() -> Iterator {
    Iterator()
  struct Iterator: AsynchreatorProtocol {
    var current = 0
    mutating func next() async -> Int? {
       current < 3 ? current : nil
} // Usage:
for await value in Counter() {
  print(value) // 0, 1, 2
```

Use Case:

Consume values from streams like timers, APIs, or custom async collections. Think of it as: for-in, but with pauses — works over time

ResultBuilder

Explanation:

Power behind SwiftUI DSL — lets you build structured data using code blocks.

Example:

```
@resultBuilder
struct StringBuilder {
 static func buildBlock(_ components: String...) -> String {
    components.joined(separator: "")
func greet(@StringBuilder builder: () -> String) {
  print(builder())
greet {
  "Hello"
  "Swift"
  "6"
```


Create custom builders like SwiftUI's ViewBuilder.

Sequence and Collection

Explanation:

Foundation protocols that power iteration (for-in) and index-based access.

Example:

```
struct CustomList: Collection {
    let data = ["A", "B", "C"]
    var startIndex: Int { data.startIndex }
    var endIndex: Int { data.endIndex }

    subscript(index: Int) -> String { data[index] }
    func index(after i: Int) -> Int { i + 1 }
}
```

Service Use Case:

Create custom iterable or subscriptable types.

Note: Collection refines Sequence and adds index-based access.

Error (Custom Error Types)

Explanation:

Defines a custom error that can be thrown or caught in Swift's error-handling system.

Example:

```
enum LoginError: Error {
    case invalidCredentials, networkError
}
func login() throws {
    throw LoginError.invalidCredentials
}
do {
    try login()
} catch {
    print("Login failed:", error)
}
```

Use Case:

Represent domain-specific or business logic errors.

Layout (SwiftUI 2023+)

Explanation:

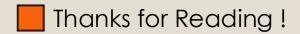
Used for building custom layout containers in SwiftUI.

Example:

```
struct MyLayout: Layout {
  func sizeThatFits(proposal: ProposedViewSize, subviews: Subviews, cache: inout ()) ->
CGSize {
    // Compute layout size here
    return CGSize(width: 100, height: 50)
  func placeSubviews(in bounds: CGRect, proposal: ProposedViewSize, subviews:
Subviews, cache: inout ()) {
    // Place subviews
```

Use Case:

Create advanced layouts beyond HStack/VStack/ZStack. (Available from iOS 16+ / SwiftUI 4.0)



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