Modules and Services

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I. Introduction to Services

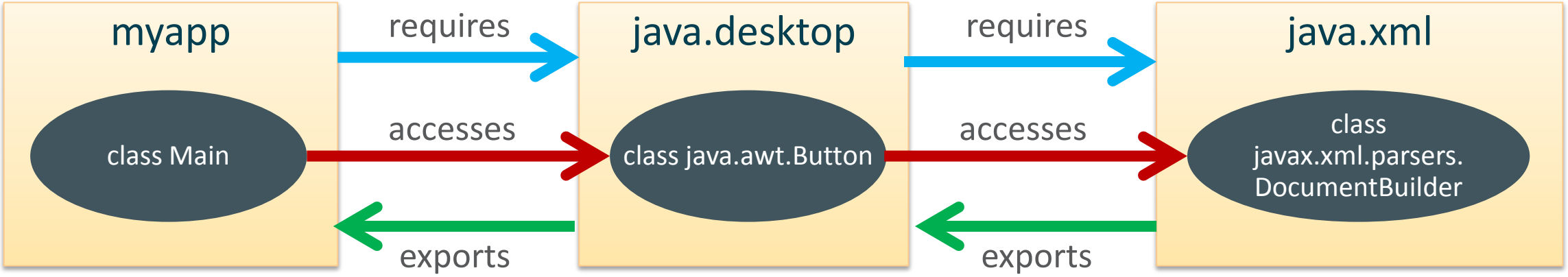
II. Services for Optional Dependencies

III. Service Binding

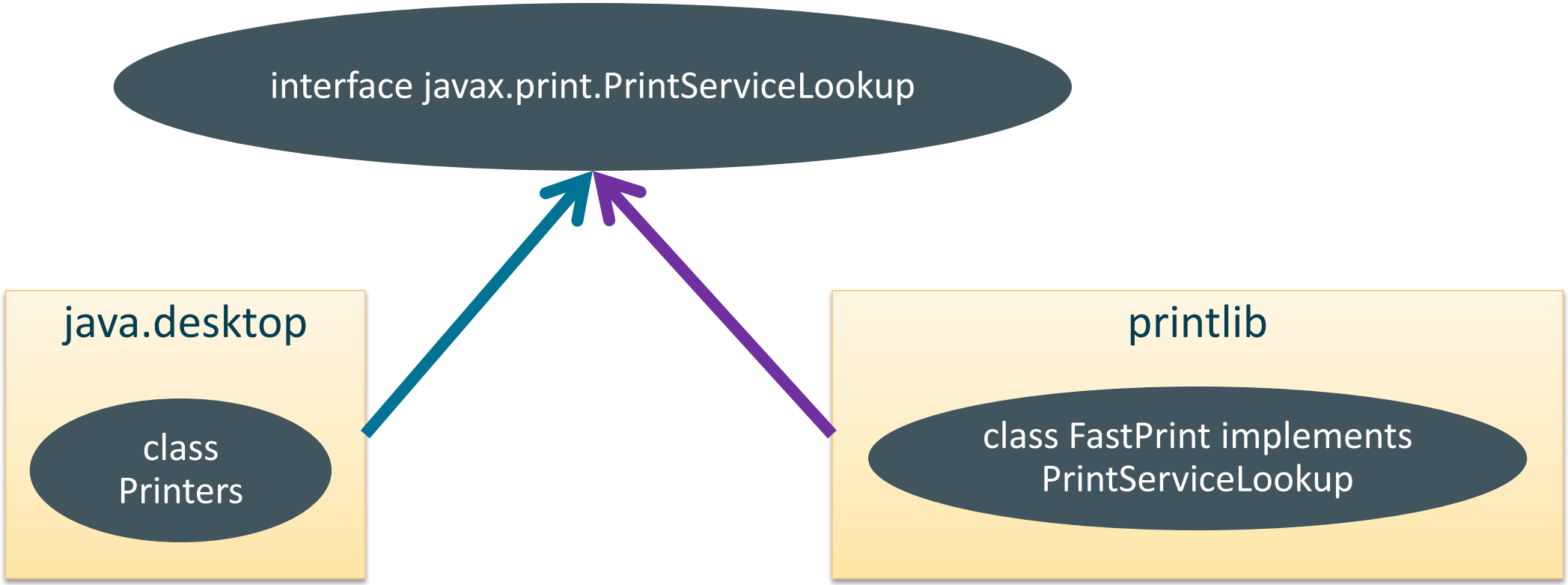
Part I. Introduction to Services

Module Dependencies

```
module java.desktop {
  requires java.xml;
  exports java.awt;
}
```



Service Relationships



Expressing Service Relationships

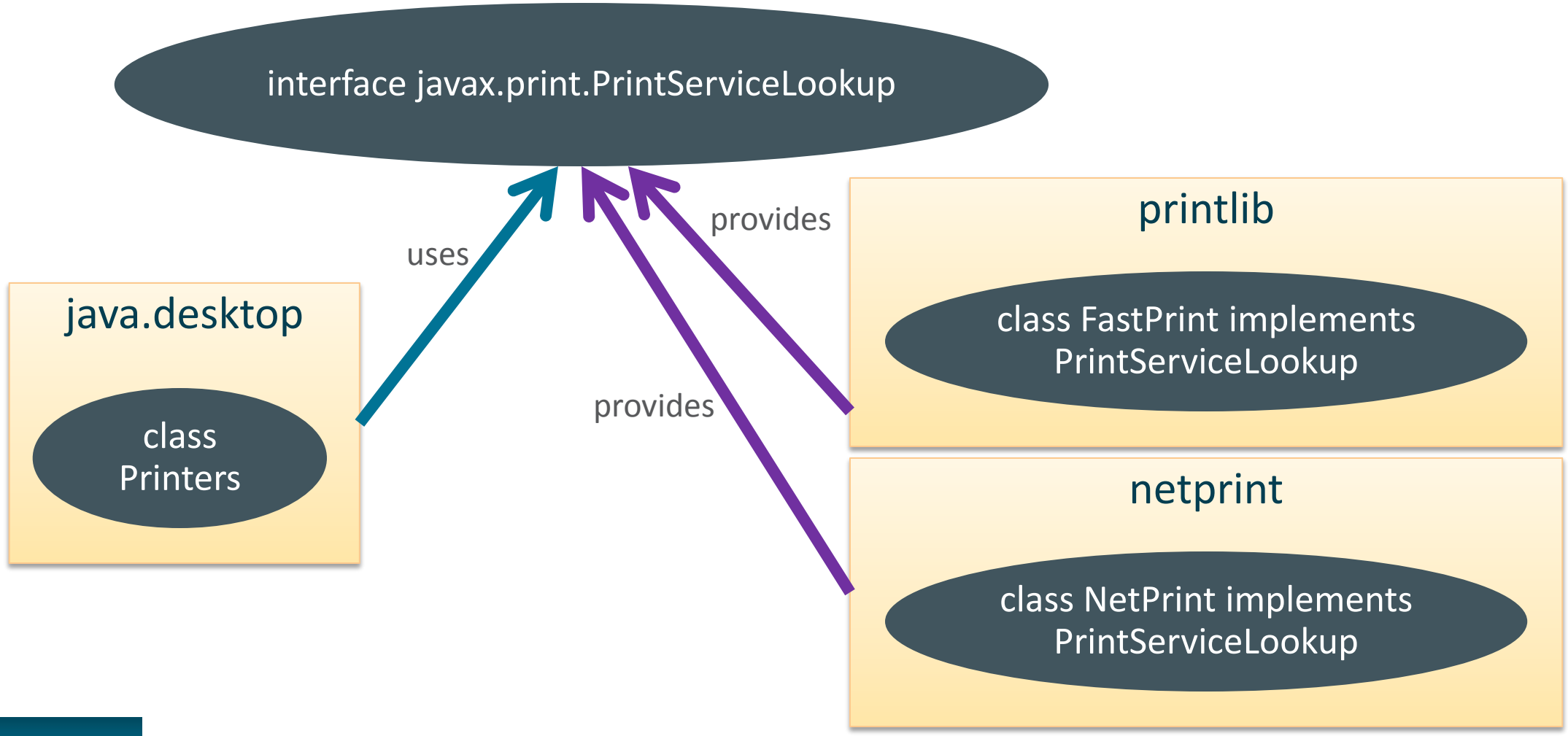
```
// Consumer module
module java.desktop {
  requires java.xml;
  exports java.awt;
  uses javax.print.PrintServiceLookup;
}
```

```
// Provider module
module printlib {
  provides javax.print.PrintServiceLookup
      with com.printlib.FastPrint;
}
```

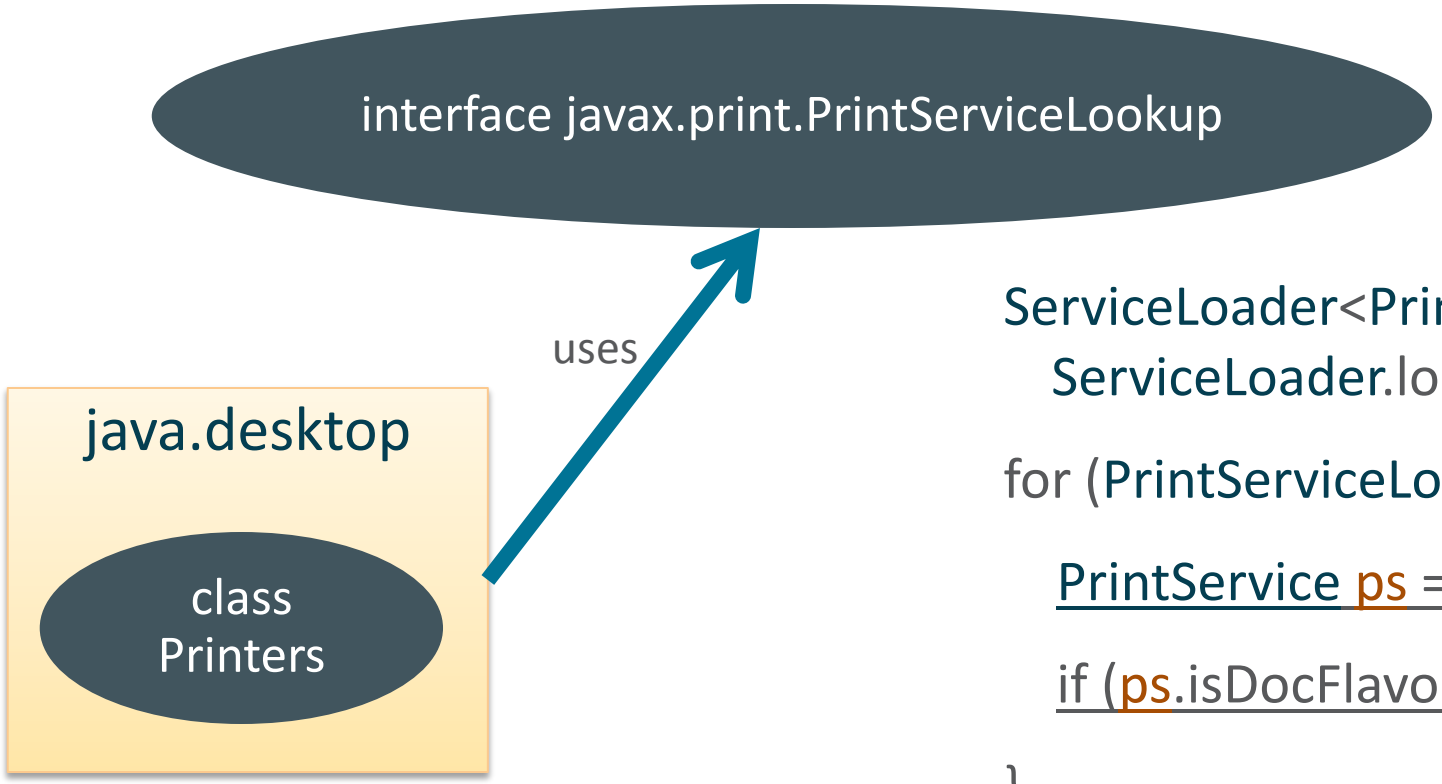
Using The Service Type in java.desktop

```
ServiceLoader<PrintServiceLookup> psls =
  ServiceLoader.load(PrintServiceLookup.class);

for (PrintServiceLookup psl : psls) {
  PrintService ps = psl.getDefaultPrintService();
  if (ps.isDocFlavorSupported(…)) return ps;
}

return DEFAULT_PRINT_SERVICE;
```

Choosing a Provider Class



Choosing a Provider Class




```
ServiceLoader<PrintServiceLookup> psls =
   ServiceLoader.load(PrintServiceLookup.class);

for (PrintServiceLookup psl : psls) {

   PrintService ps = psl.getDefaultPrintService();

   if (ps.isDocFlavorSupported(...)) return ps;

}

return DEFAULT_PRINT_SERVICE;
```

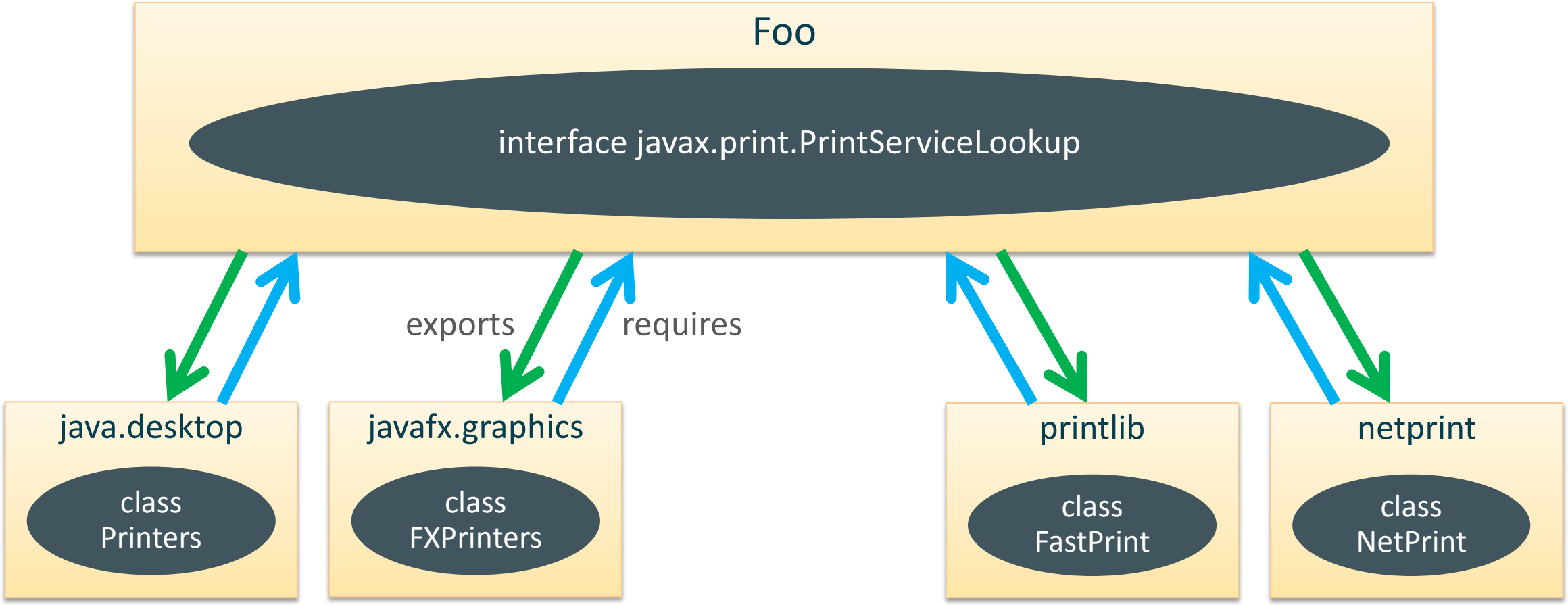
Designing a Service Type

```
interface PrintServiceLookup {
  PrintService   getDefaultPrintService();
  PrintService[] getPrintServices();
  PrintService[] getPrintServices(DocFlavor);
}
interface PrintService {
  DocFlavor[] getSupportedDocFlavors();
  boolean     isDocFlavorSupported();
  void        createPrintJob();
}
```

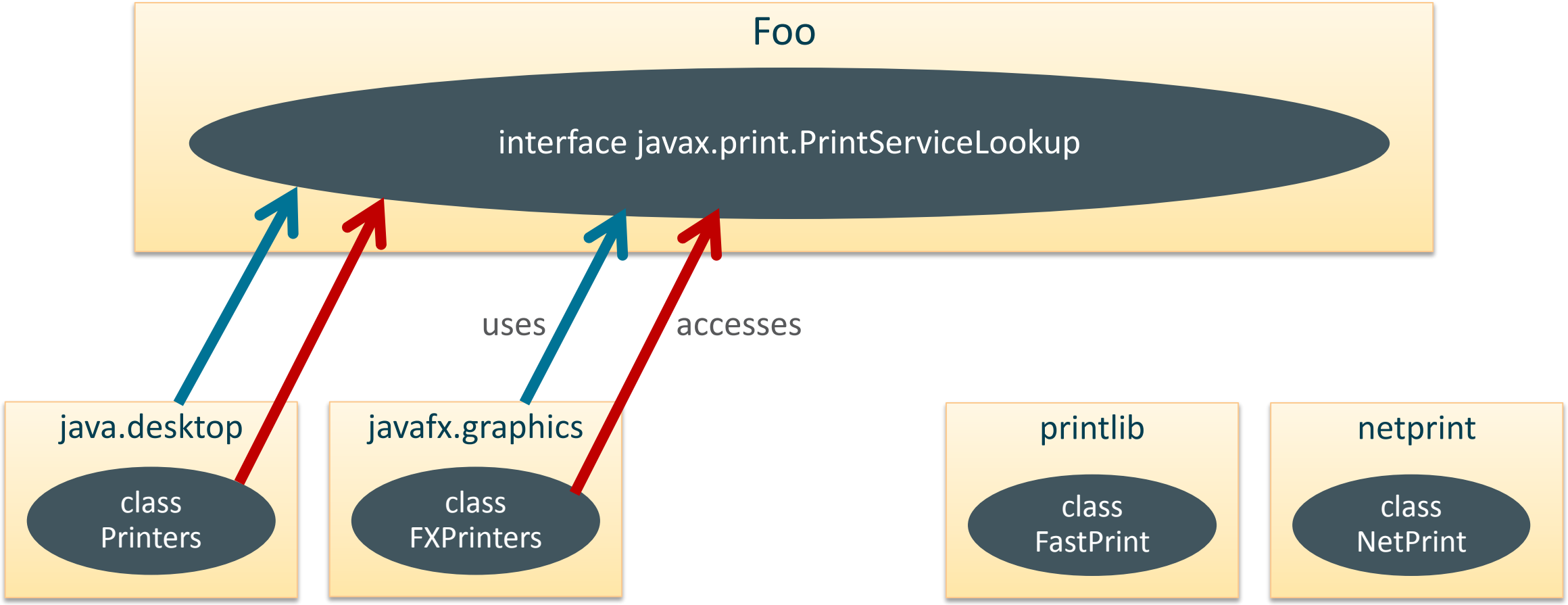
java.desktop as a Consumer Module

```
uses java.awt.im.spi.InputMethodDescriptor;
uses javax.accessibility.AccessibilityProvider;
uses javax.imageio.spi.ImageInputStreamSpi;
uses javax.imageio.spi.ImageOutputStreamSpi;
uses javax.imageio.spi.ImageReaderSpi;
uses javax.imageio.spi.ImageTranscoderSpi;
uses javax.imageio.spi.ImageWriterSpi;
uses javax.print.PrintServiceLookup;
uses javax.print.StreamPrintServiceFactory;
uses javax.sound.midi.spi.MidiDeviceProvider;
uses javax.sound.midi.spi.MidiFileReader;
uses javax.sound.midi.spi.MidiFileWriter;
uses javax.sound.midi.spi.SoundbankReader;
uses javax.sound.sampled.spi.AudioFileReader;
uses javax.sound.sampled.spi.AudioFileWriter;
uses javax.sound.sampled.spi.FormatConversionProvider;
uses javax.sound.sampled.spi.MixerProvider;
```

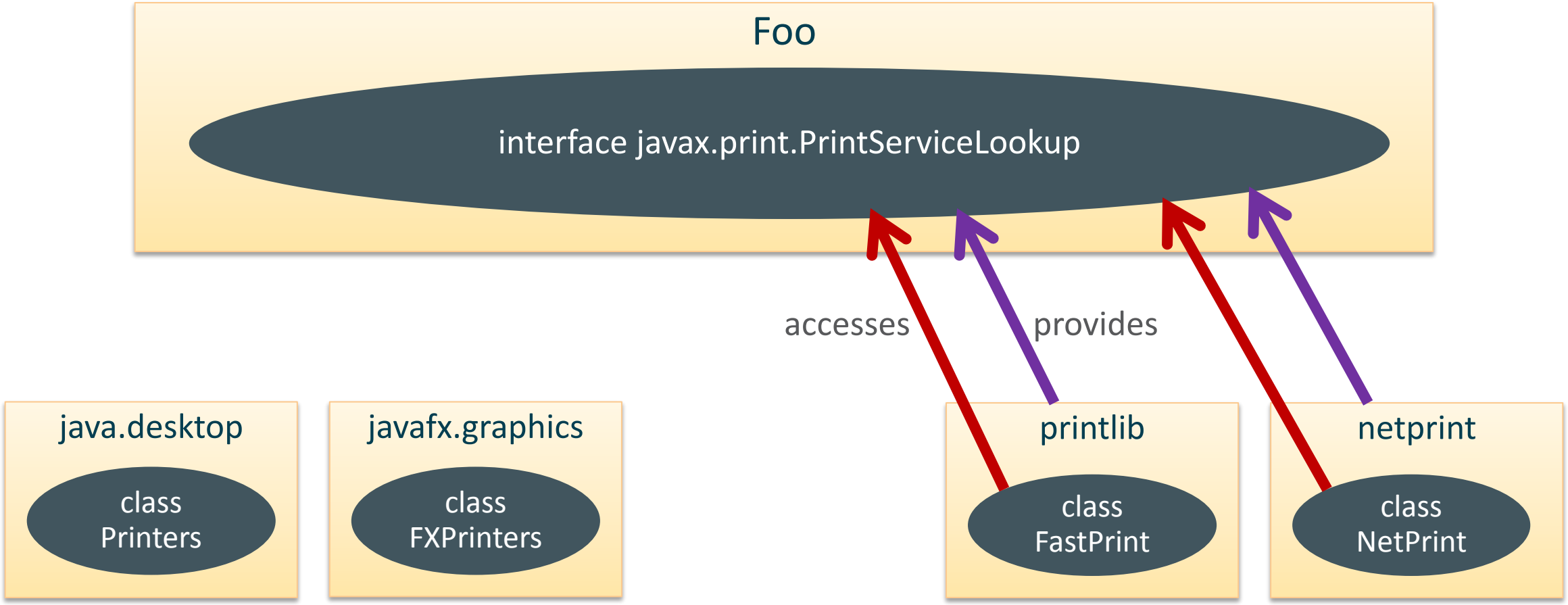
Service Types in Modules



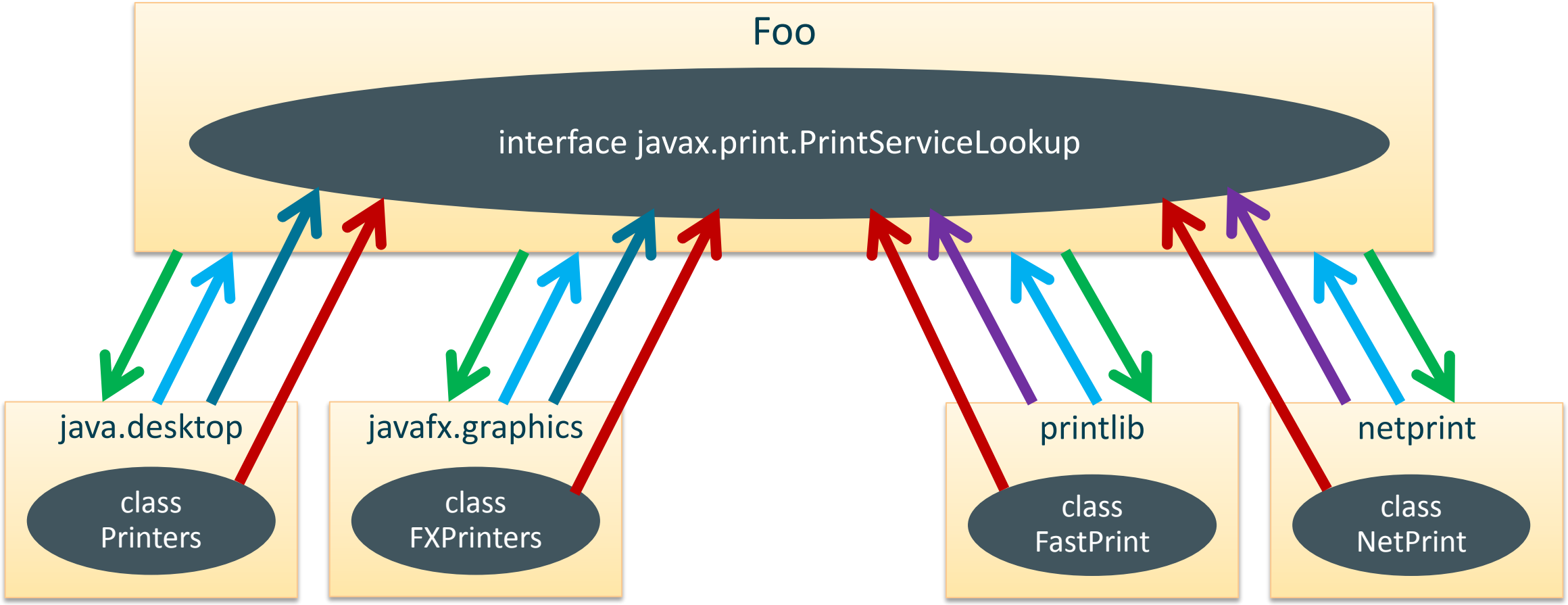
Service Types in Modules



Service Types in Modules



Service Types in Modules



Service Types in java.desktop

```
exports java.awt.im.spi;            uses java.awt.im.spi.InputMethodDescriptor;
exports javax.accessibility;        uses javax.accessibility.AccessibilityProvider;
exports javax.imageio.spi;          uses javax.imageio.spi.ImageInputStreamSpi;
                                    uses javax.imageio.spi.ImageOutputStreamSpi;
                                    uses javax.imageio.spi.ImageReaderSpi;
                                    uses javax.imageio.spi.ImageTranscoderSpi;
                                    uses javax.imageio.spi.ImageWriterSpi;
exports javax.print;                uses javax.print.PrintServiceLookup;
                                    uses javax.print.StreamPrintServiceFactory;
exports javax.sound.midi.spi;       uses javax.sound.midi.spi.MidiDeviceProvider;
                                    uses javax.sound.midi.spi.MidiFileReader;
                                    uses javax.sound.midi.spi.MidiFileWriter;
                                    uses javax.sound.midi.spi.SoundbankReader;
exports javax.sound.sampled.spi;    uses javax.sound.sampled.spi.AudioFileReader;
                                    uses javax.sound.sampled.spi.AudioFileWriter;
                                    uses javax.sound.sampled.spi.FormatConversionProvider;
                                    uses javax.sound.sampled.spi.MixerProvider;
```

java.desktop as a Provider Module

```
uses javax.print.PrintServiceLookup;
                                        provides javax.print.PrintServiceLookup
                                            with sun.print.PrintServiceLookupProvider;

uses javax.print.StreamPrintServiceFactory;
                                        provides javax.print.StreamPrintServiceFactory
                                            with sun.print.PSStreamPrinterFactory;

uses javax.sound.sampled.spi.AudioFileReader;
                                        provides javax.sound.sampled.spi.AudioFileReader
                                            with com.sun.media.sound.AiffFileReader;
                                        provides javax.sound.sampled.spi.AudioFileReader
                                            with com.sun.media.sound.AuFileReader;
                                        provides javax.sound.sampled.spi.AudioFileReader
                                            with com.sun.media.sound.WaveFileReader;
```

Using The Service Type (Advanced)

```
Stream<Provider<PrintServiceLookup>> providers =
  ServiceLoader.load(PrintServiceLookup.class)
    .stream()
    .filter(p -> p.type().isAnnotationPresent(…));

PrintServiceLookup psl =
  providers.map(Provider::get)
    .findAny()
    .orElse(DEFAULT_PRINT_SERVICE);
```

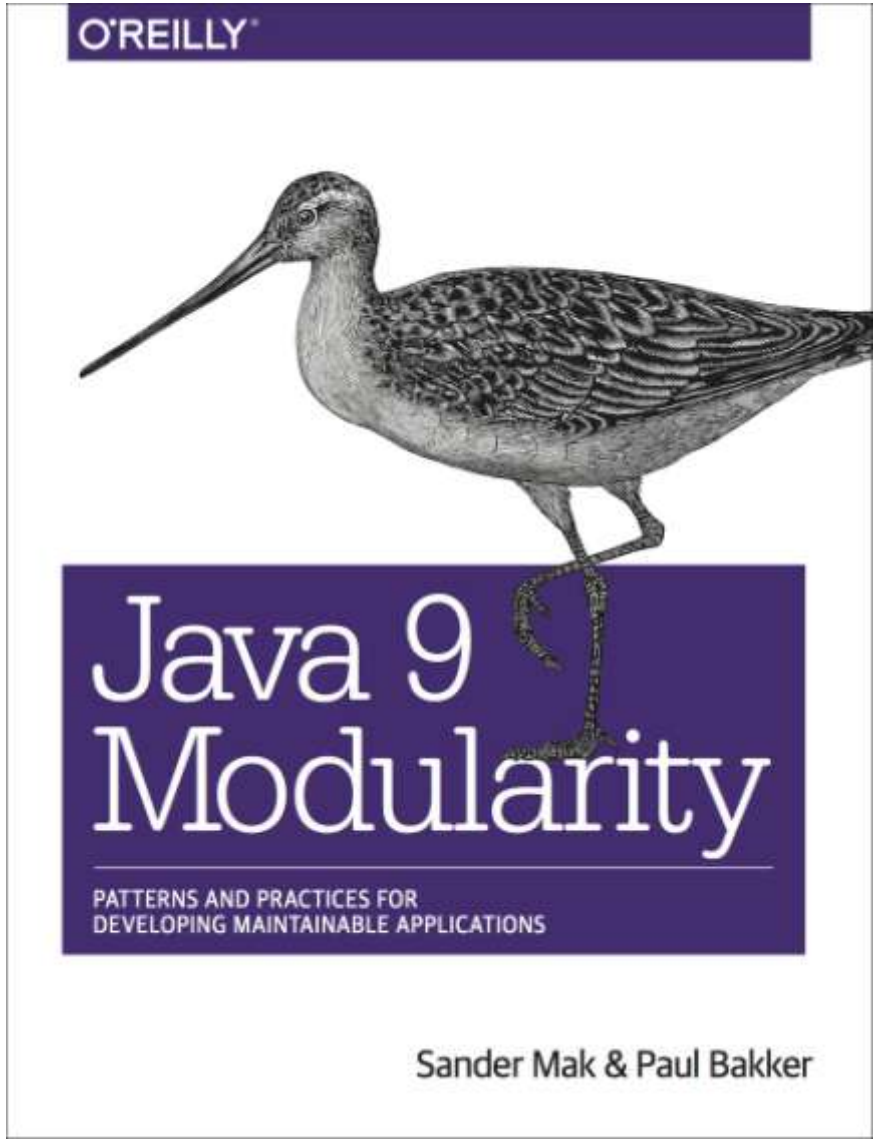
Documenting Services

```
module java.desktop {
  /**
   * @uses javax.print.PrintServiceLookup Supports providers that …
   */
  uses javax.print.PrintServiceLookup;
}

module printlib {
  /**
   * @provides javax.print.PrintServiceLookup The FastPrint class can …
   */
  provides javax.print.PrintServiceLookup with com.printlib.FastPrint;
}
```

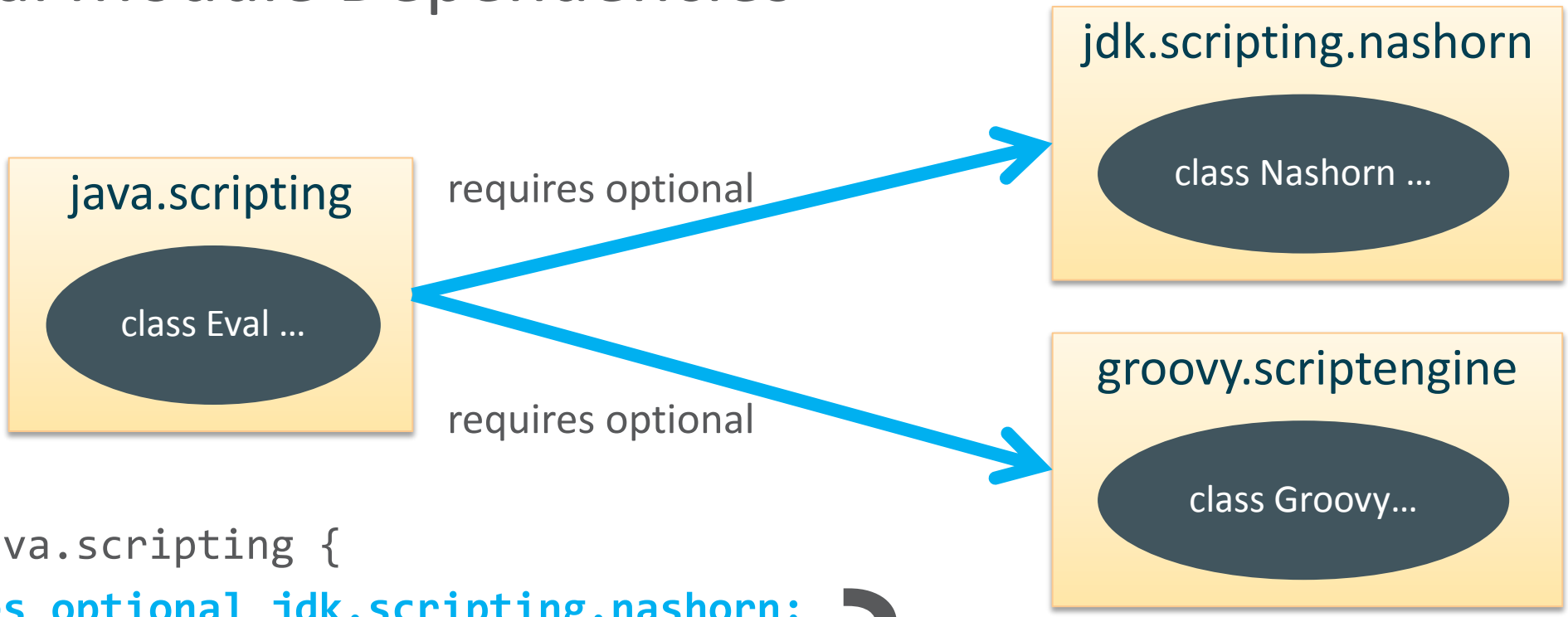
Summary of Part I. Introduction to Services

- Service relationships are first class in the module system
- Programming against service types means providers can be encapsulated
- Many JDK frameworks build on services, and are customized with them

Part II. Services for Optional Dependencies



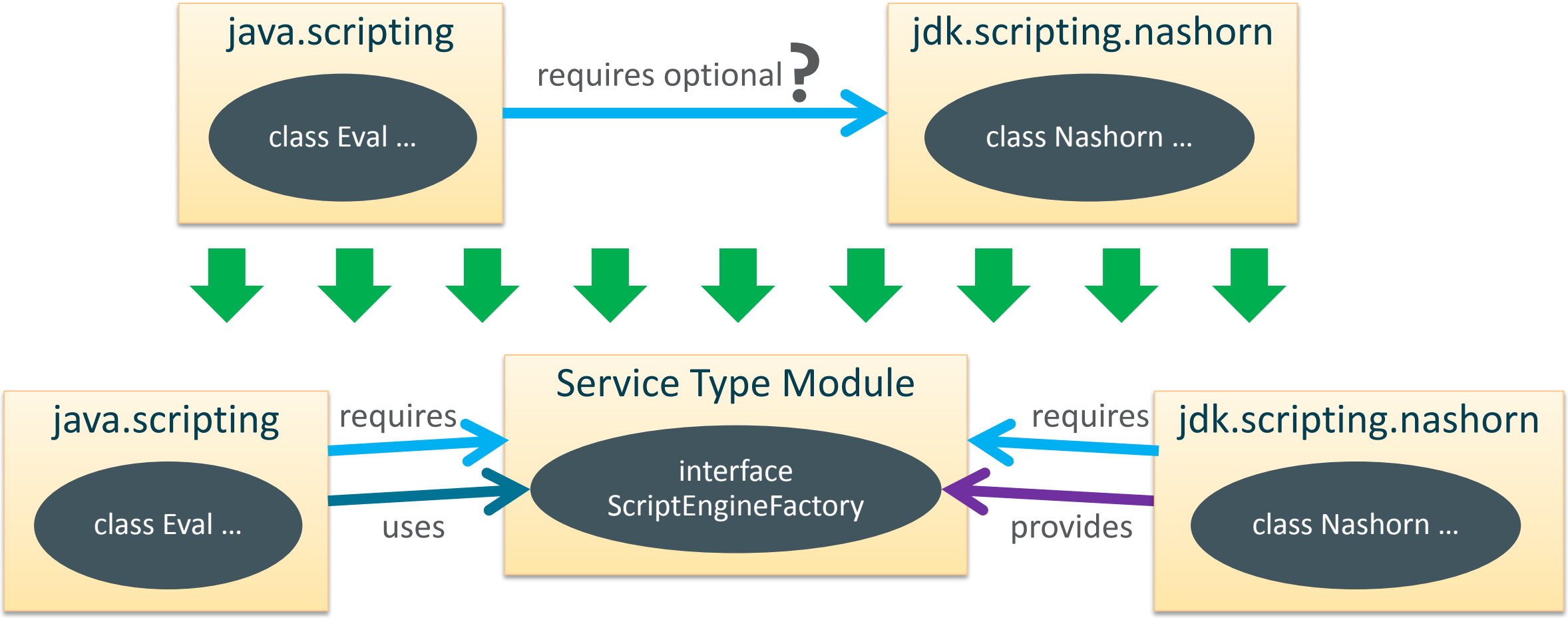
Optional Module Dependencies




```
module java.scripting {
  requires optional jdk.scripting.nashorn;
  requires optional groovy.scriptengine;
}
```

?

Encoding Optionality with Service Relationships



Encoding Optionality

```
module java.scripting {
  uses javax.script.ScriptEngineFactory;
  exports javax.script;
}
```

```
module jdk.scripting.nashorn {
  provides javax.script.ScriptEngineFactory
      with jdk.nashorn.api.scripting.NashornScriptEngineFactory;
  requires java.scripting;
}
module groovy.scriptengine {
  provides javax.script.ScriptEngineFactory
      with groovy.backend.CodeEvaluationEngineFactory;
  requires java.scripting;
}
```

Summary of Part II. Optional Dependencies

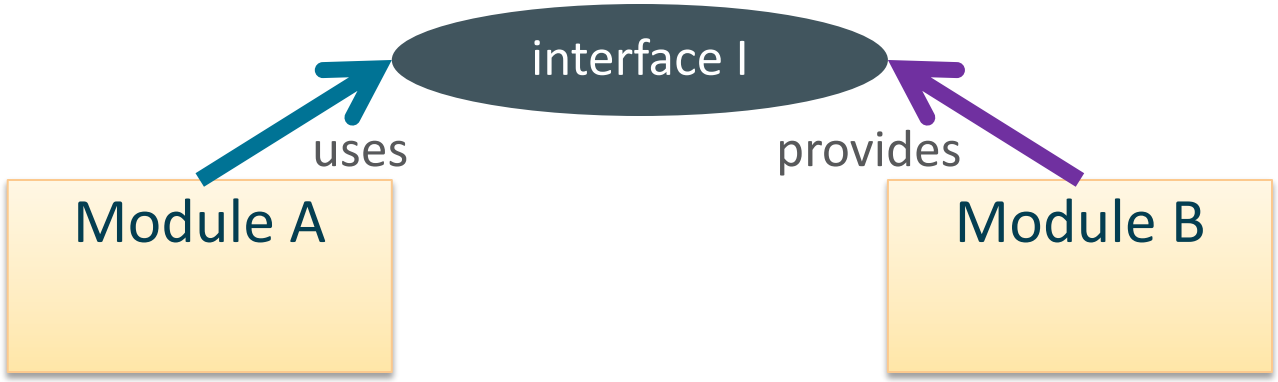
- Service relationships encode optional module dependencies
- Services give not just loose coupling, but better separation of concerns
- Services are almost always a better choice than messing with reflection

Part III: Service Binding

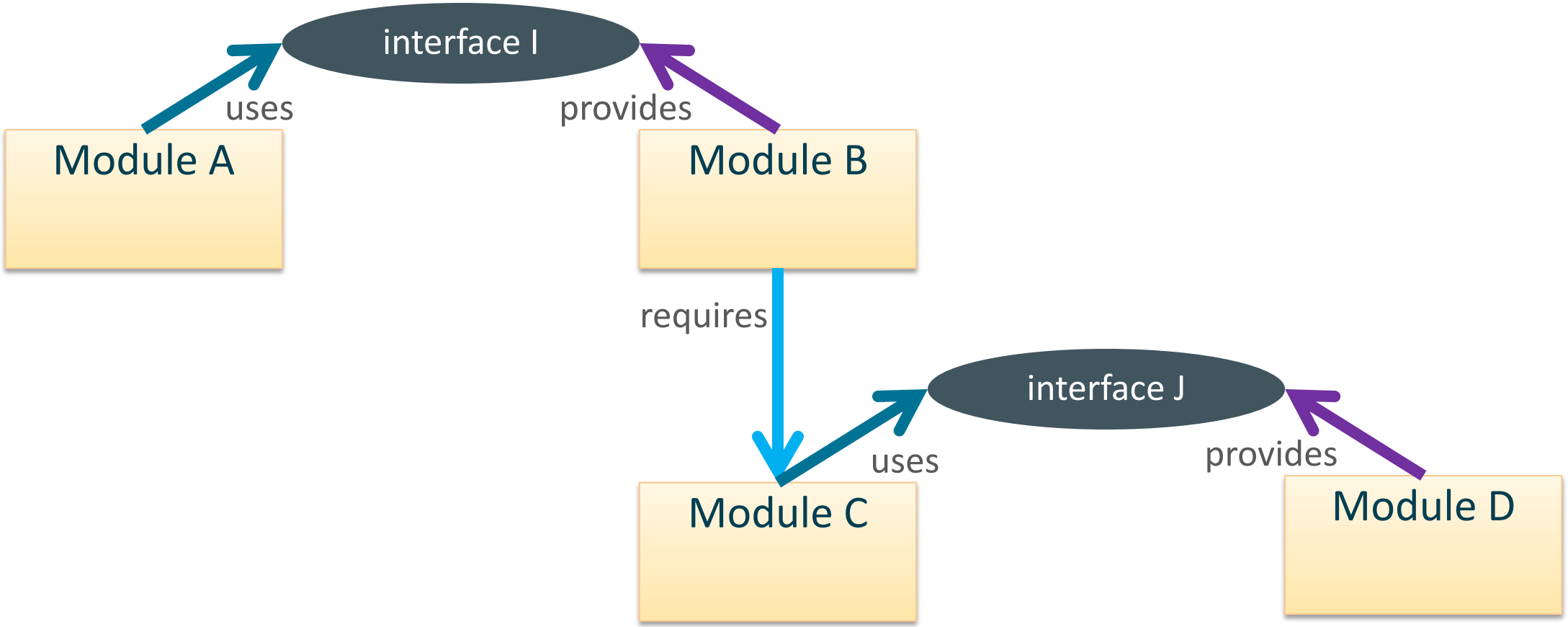
Why Declare Services In The Module System?

- Strong encapsulation
- Reliable configuration

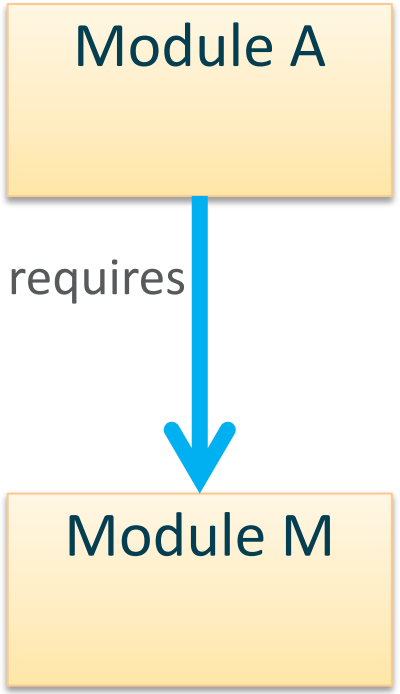
Service Binding



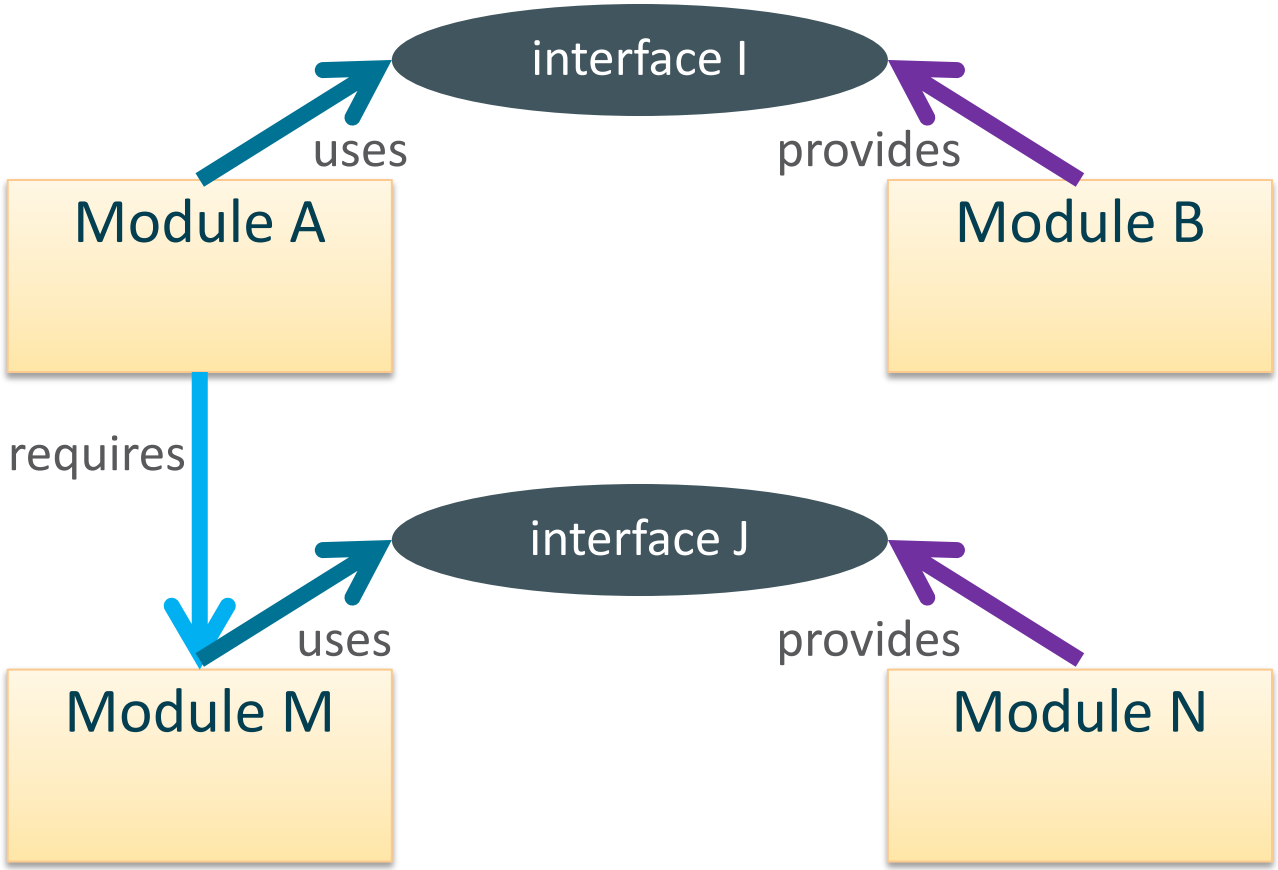
Service Binding



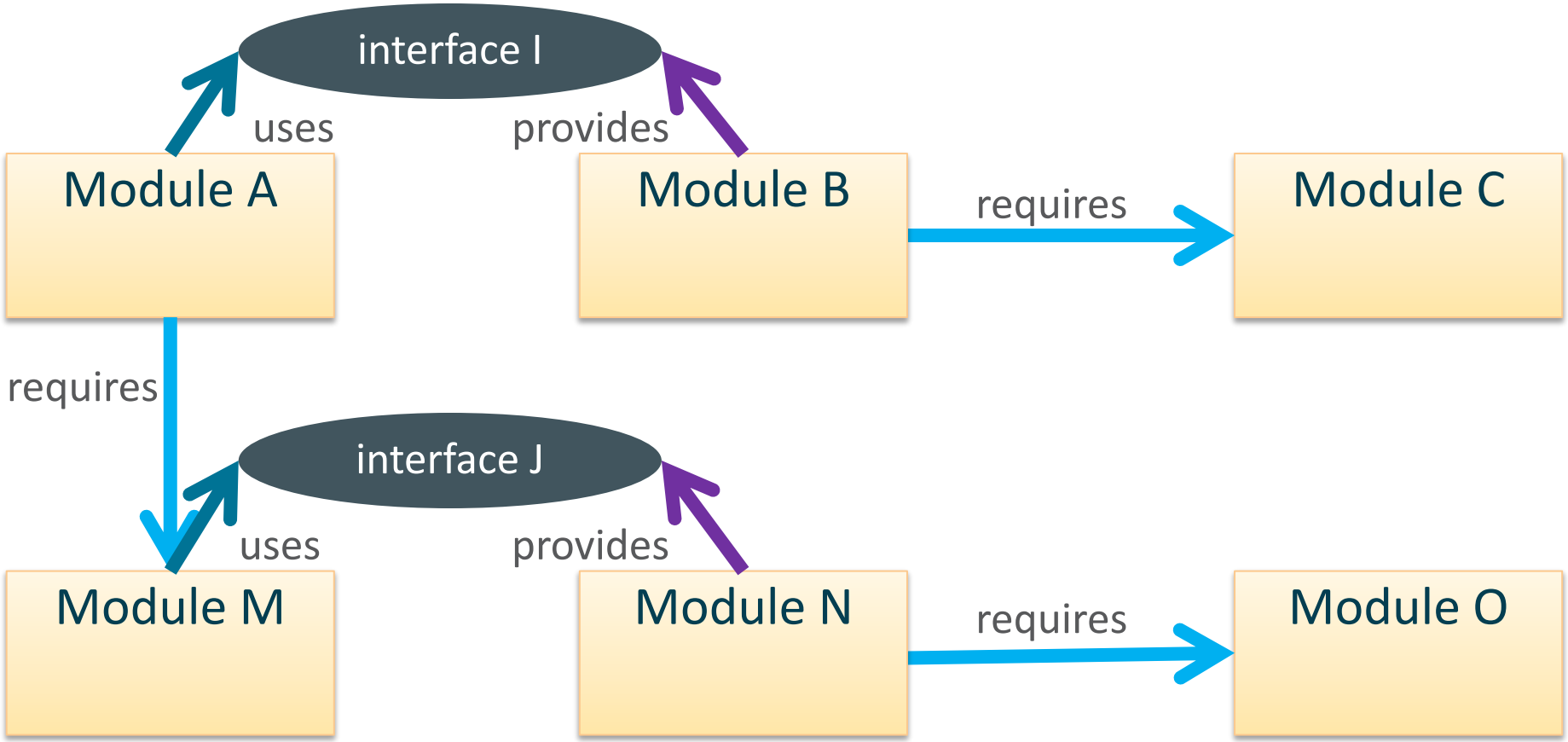
Module Resolution with Service Binding



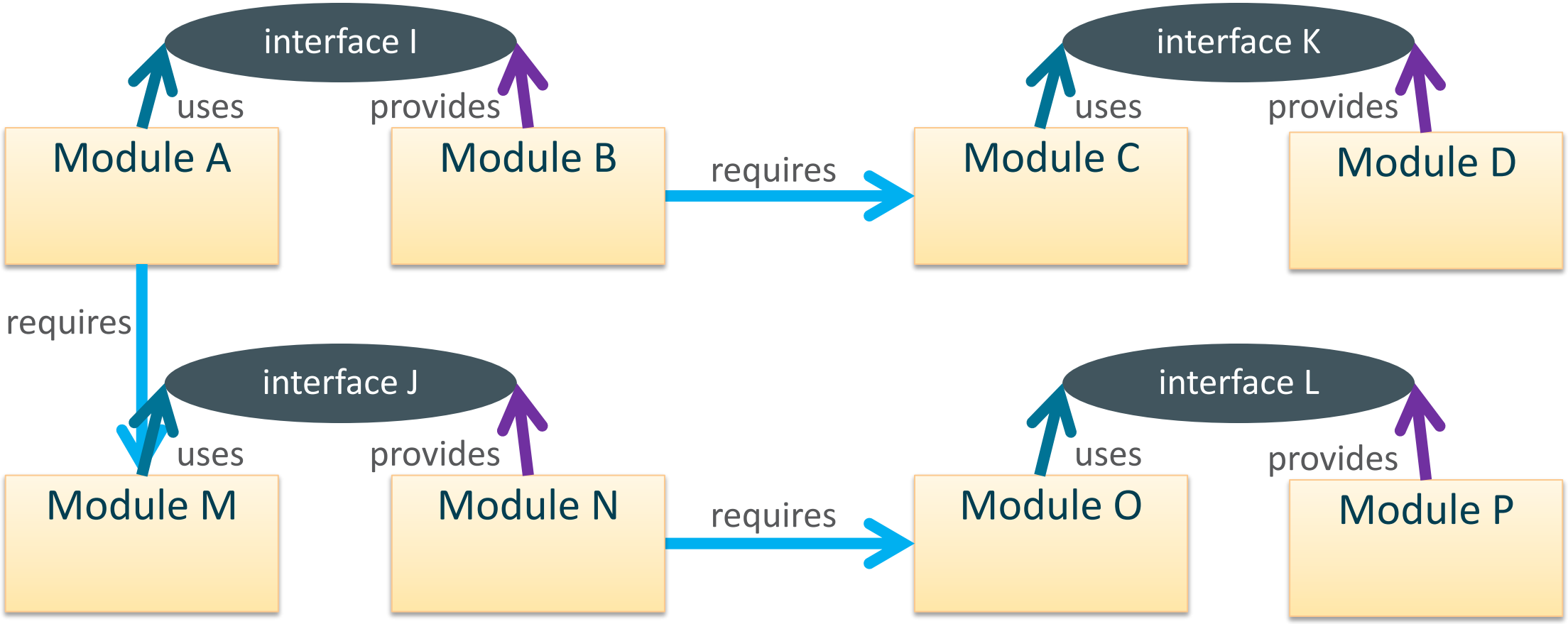
Module Resolution with Service Binding



Module Resolution with Service Binding



Module Resolution with Service Binding



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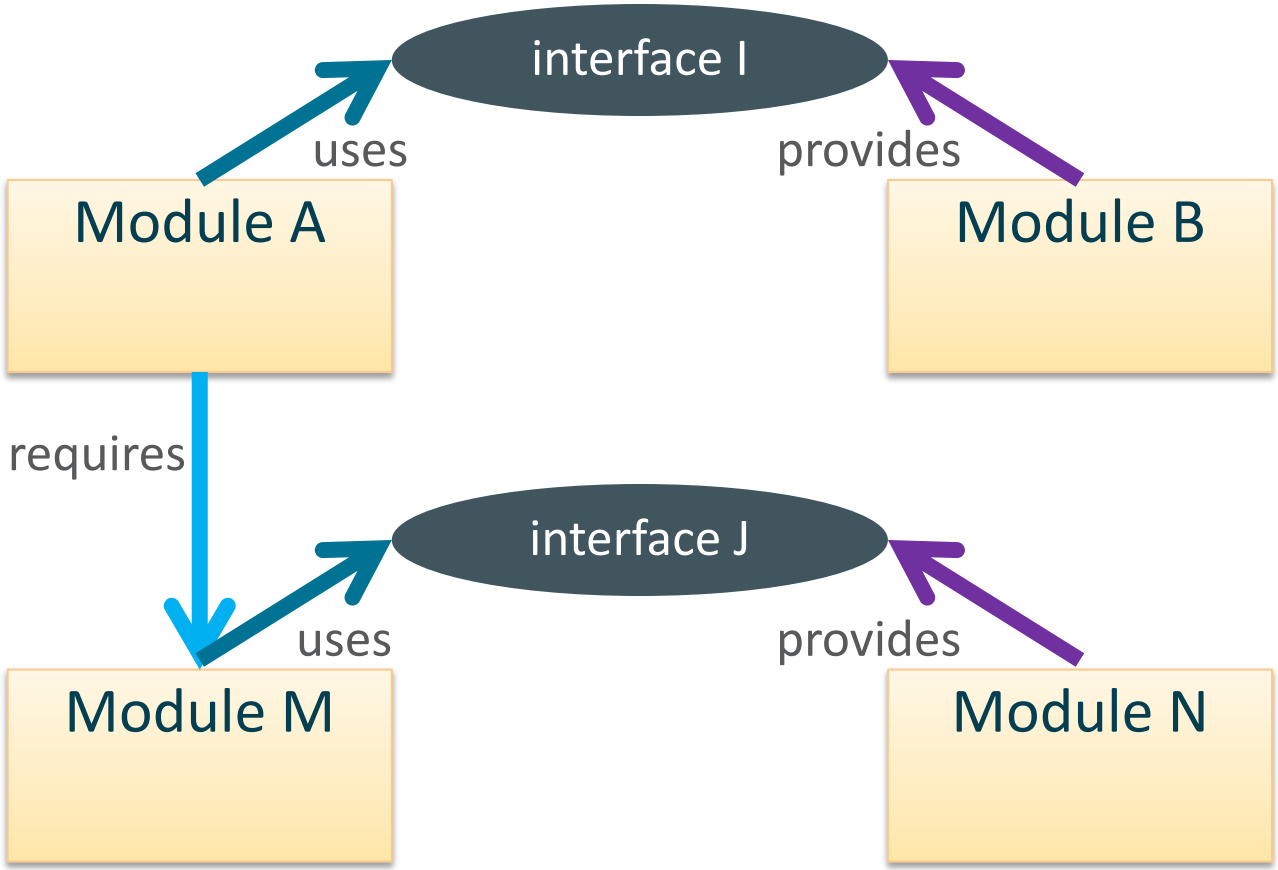

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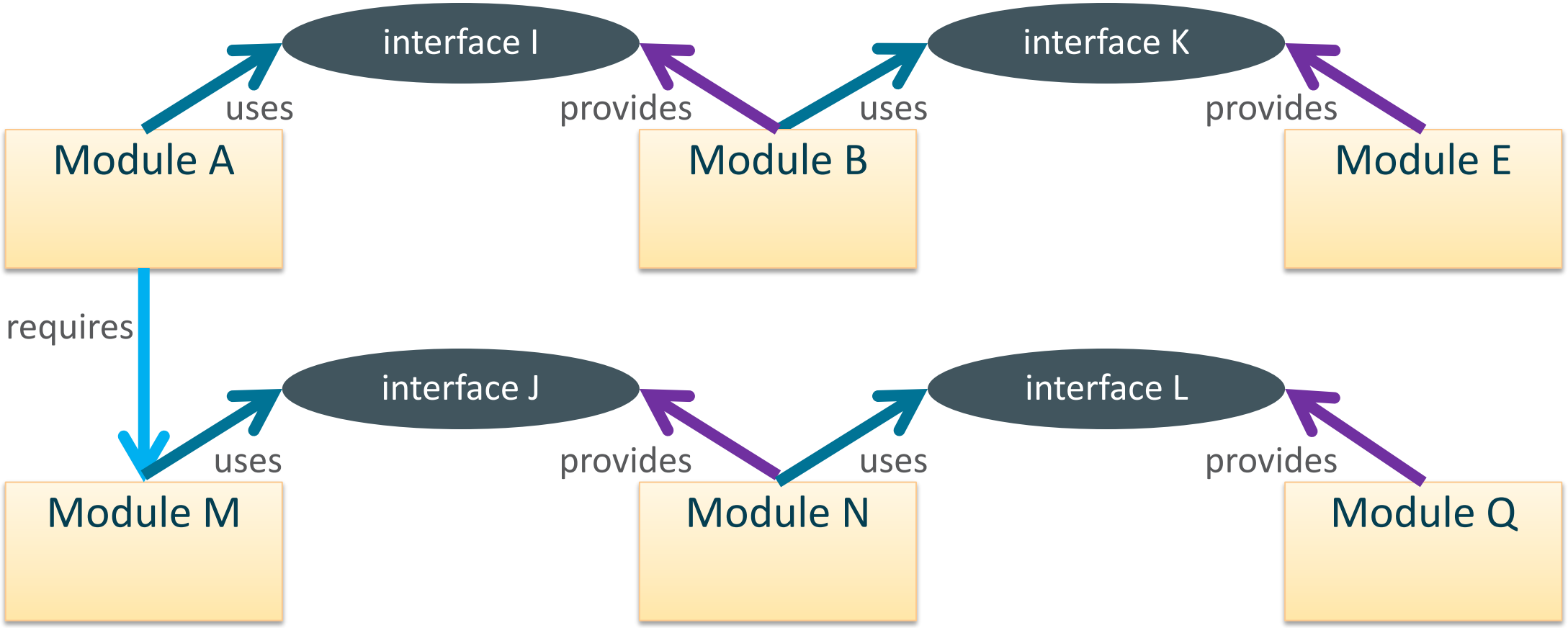
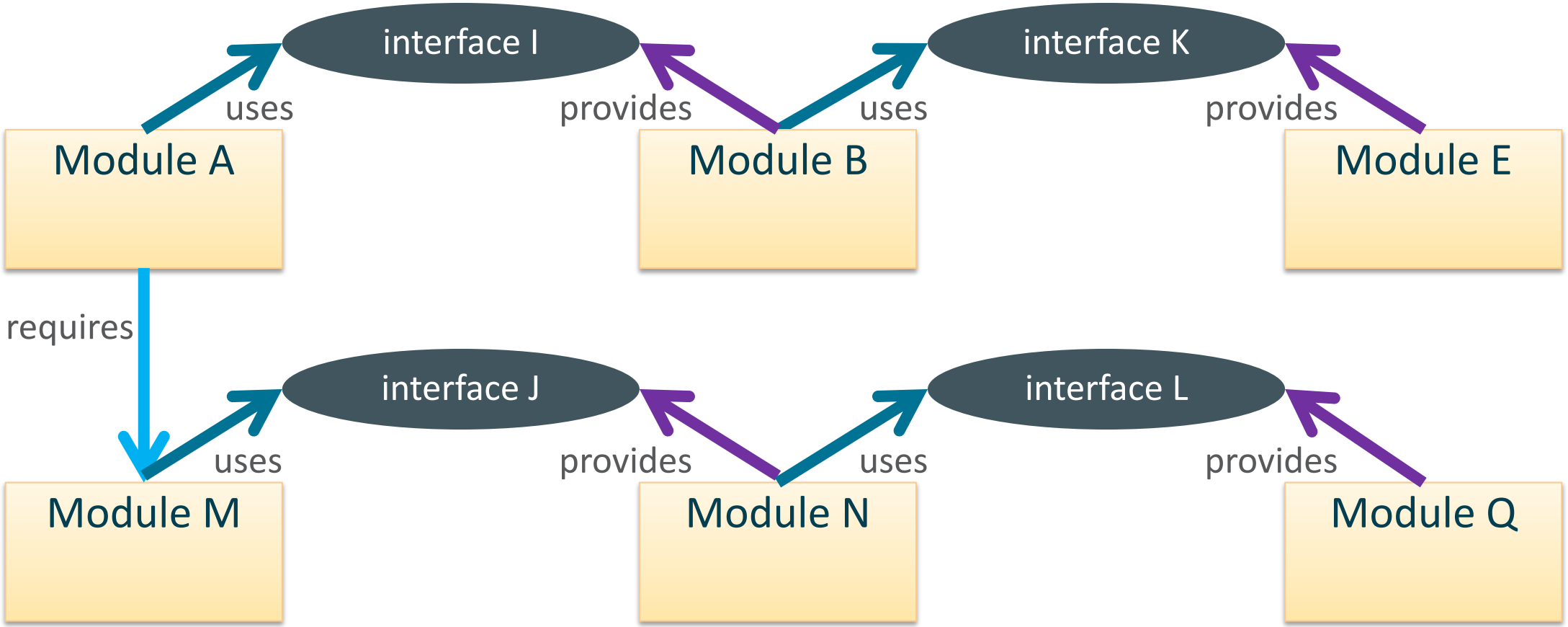
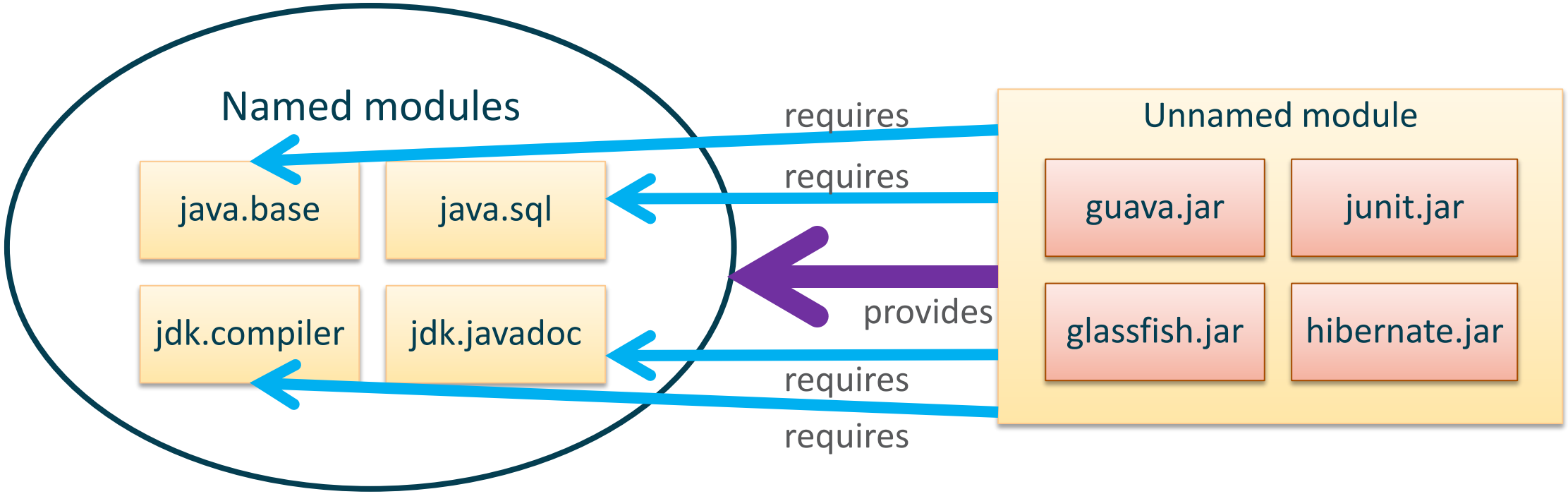


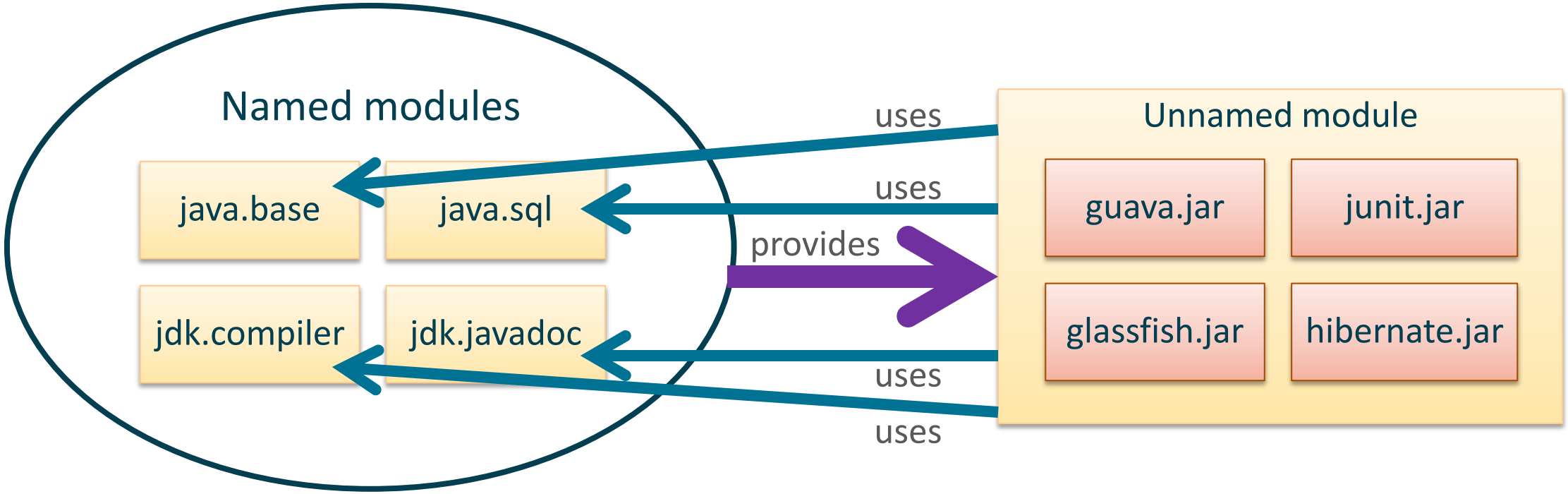
jlink and Service Relationships



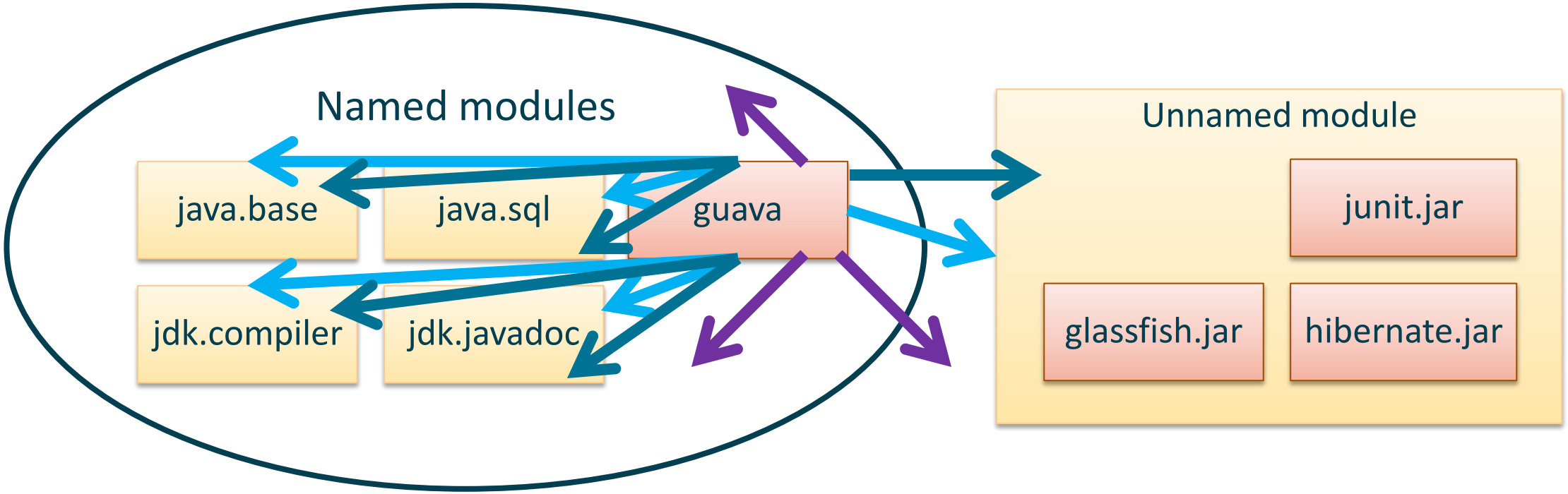
Services and the Unnamed Module



Services and the Unnamed Module



Services and Automatic Modules



Summary of Part III. Service Binding

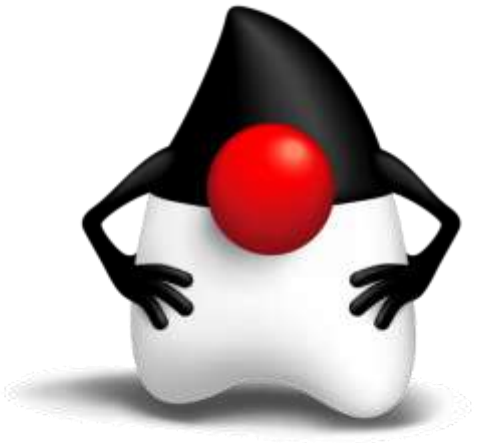
- Service binding is an iterative process that augments the module graph
- Service binding is agnostic to explicit, automatic, and unnamed modules
- Service binding is orthogonal to linking a Java runtime image

Summary of Summaries

- Service relationships are first class in the module system
- Services give not just loose coupling, but better separation of concerns
- Service binding is agnostic to explicit, automatic, and unnamed modules

Preparing for JDK 9

- JDK 8: Run *jdeps –jdkinternals MyApp.jar*
- JDK 9: Early Access binaries at http://jdk9.java.net/
- JEP 261: Module System
- JEP 260: Encapsulate Most Internal APIs
- JEP 223: New Version String Scheme
- JEP 220: Modular Run-Time Images
- JEP 200: The Modular JDK



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