Paris, France

OSGi™ Alliance

2005 Developer Forum & World Congress

Paris, France

Automatically Managing Service Dependencies in an OSGi Environment

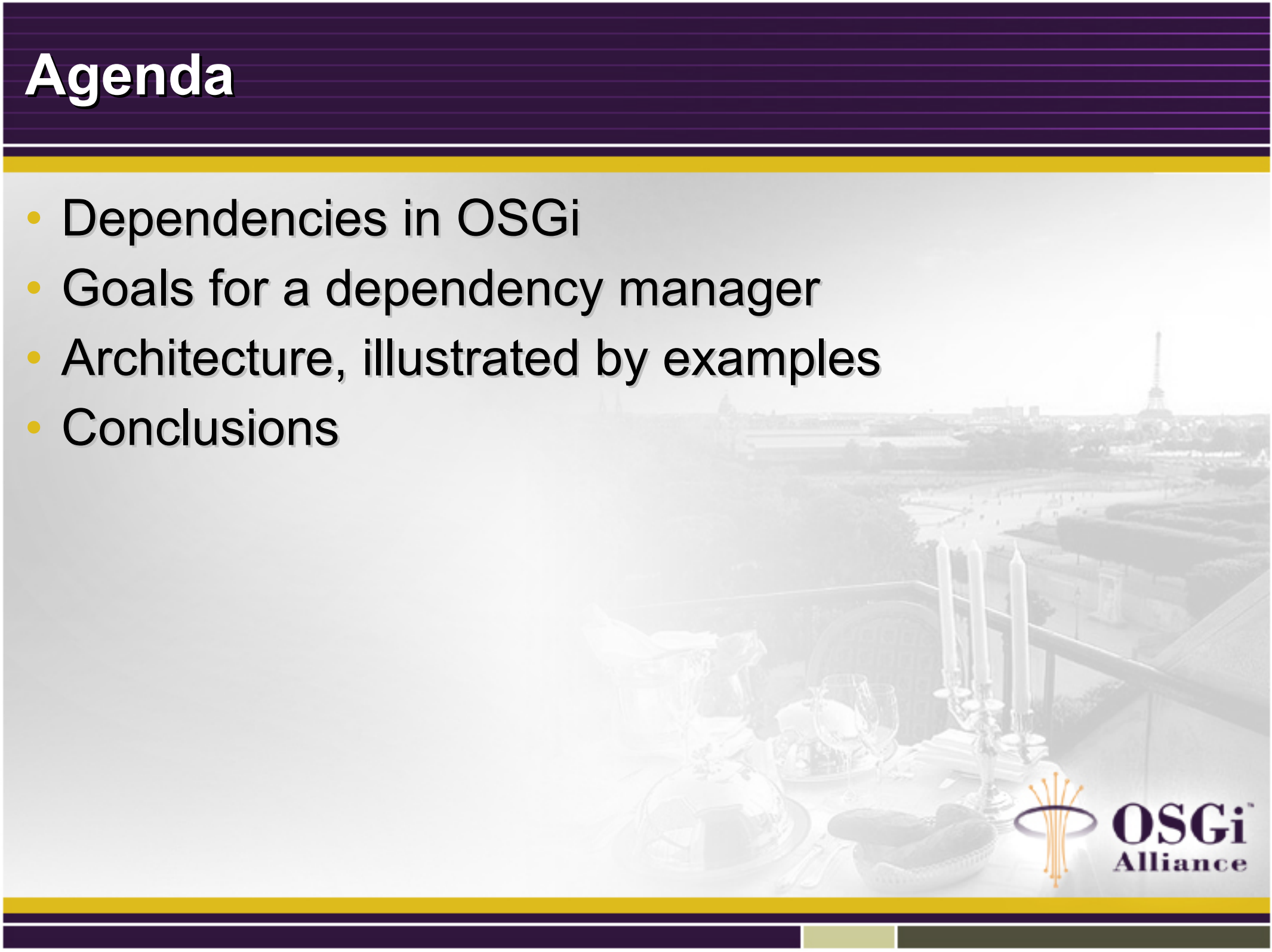
Marcel Offermans

About me...

- Marcel Offermans
- Senior Software Engineer at luminis®
- Our mission is to provide knowledge and products to organisations who create software intensive products, to help them adopt software technology innovations.
- We use OSGi at the core of the architecture for managable, embedded systems.

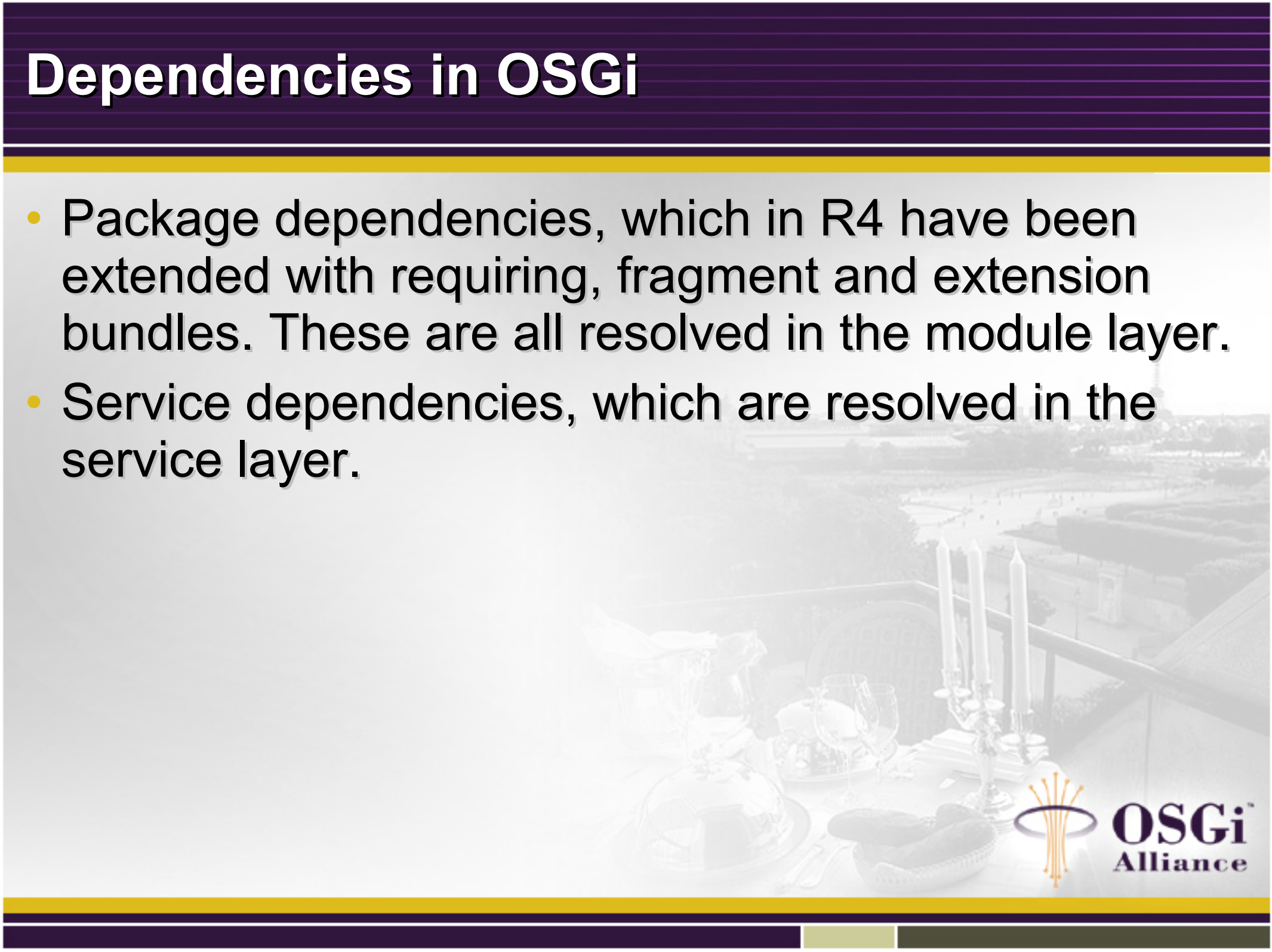
Agenda

- Dependencies in OSGi
- Goals for a dependency manager
- Architecture, illustrated by examples
- Conclusions



Dependencies in OSGi

- Package dependencies, which in R4 have been extended with requiring, fragment and extension bundles. These are all resolved in the module layer.
- Service dependencies, which are resolved in the service layer.



Service Dependencies

- Need to be managed at runtime
- The OSGi framework offers basic tools:
  - Service listener
  - Service tracker
- Third party tools:
  - Service binder
  - ...probably there are more :)

OSGi Alliance

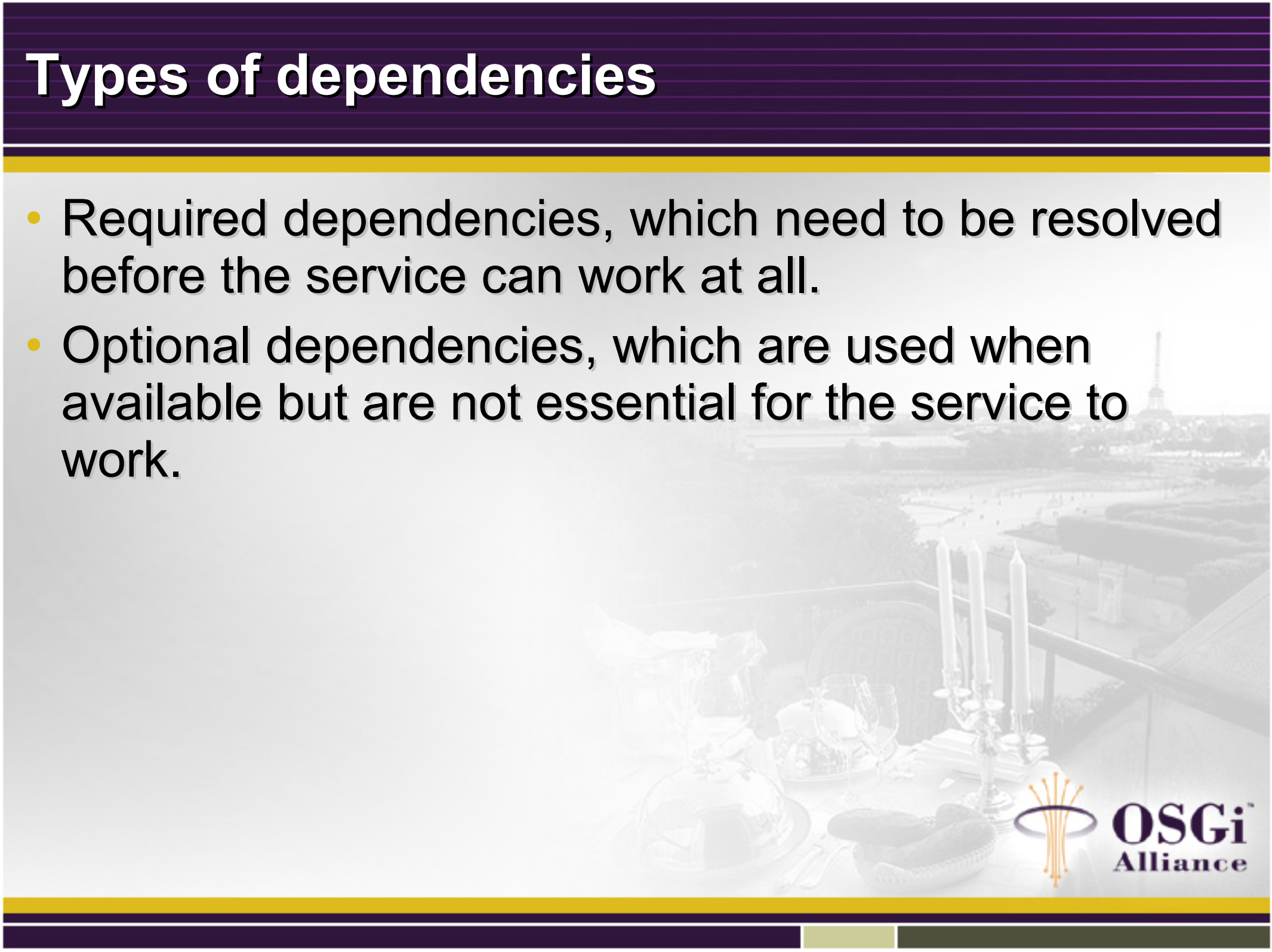
Goals for the Dependency Manager

- Minimize the amount of code that needs to be written.
- Provide a clean separation between the service implementation and “glue” code.
- Be dynamic. Allow the programmer to add services and dependencies at any time.

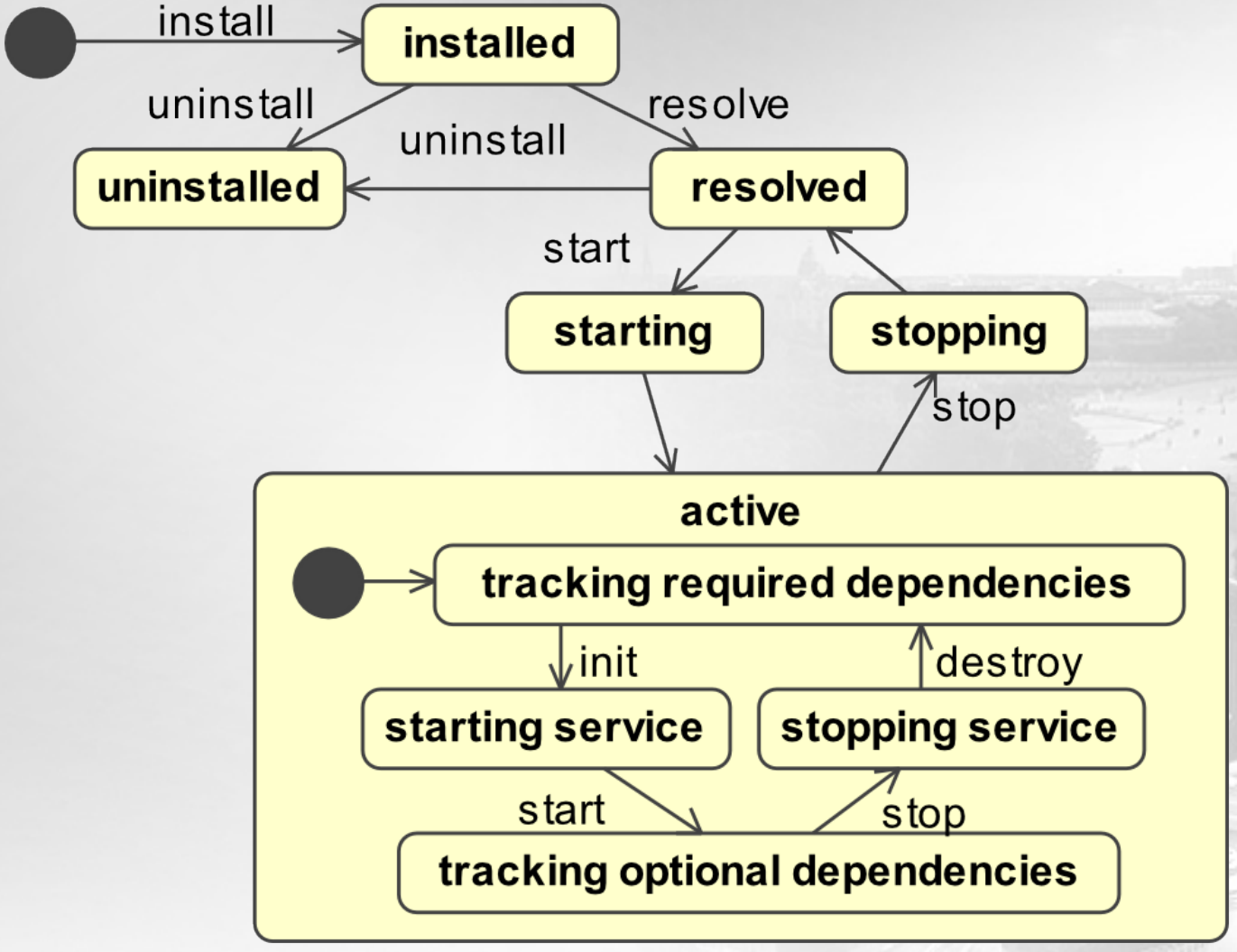
OSGi Alliance

Types of dependencies

- Required dependencies, which need to be resolved before the service can work at all.
- Optional dependencies, which are used when available but are not essential for the service to work.



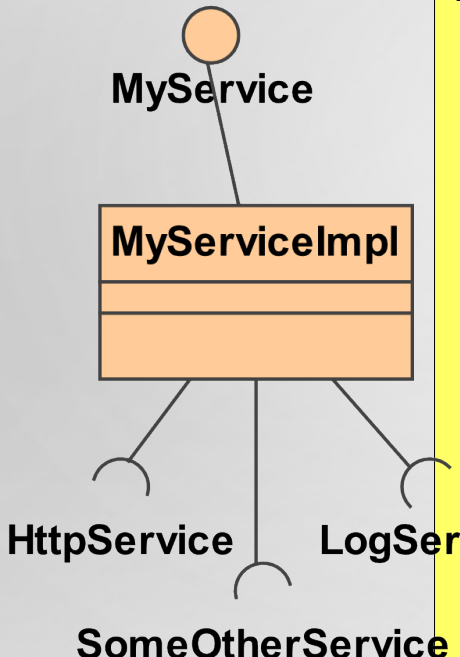
Architecture: state diagram



OSGi Alliance

Standard use case

- A service with two required dependencies and one optional one.




```
public class Activator extends DependencyActivatorBase {
  public void init(BundleContext bc, DependencyManager dm) {
    dm.add(createService()
      .setInterface(MyService.class.getName(), null)
      .setImplementation(MyServiceImpl.class)
      .add(createServiceDependency()
        .setService(HttpService.class)
        .setRequired(true))
      .add(createServiceDependency()
        .setService(SomeOtherService.class)
        .setRequired(true))
      .add(createServiceDependency()
        .setService(LogService.class)
        .setRequired(false))
      );
  }
  public void destroy(BundleContext bc, DependencyManager dm) {
  }
}
```

OSGi Alliance

Standard use case

- Implementation instantiated lazily, invokes callbacks as part of life-cycle: init, start, stop, destroy
- Dependencies are injected using reflection
- Null object pattern used for optional dependencies

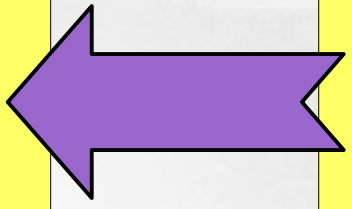
```
public class MyServiceImpl implements MyService {
  private HttpService httpService;
  private SomeOtherService someOtherService;
  private LogService logService;

  public void start() {
    logService.log(LogService.LOG_INFO, “Starting”);
  }
  public void stop() {
    logService.log(LogService.LOG_INFO, “Stopping”);
  }
}
```

Code size reduction:

```
public class Activator extends DependencyActivatorBase {
 public void init(BundleContext ctx, DependencyManager manager)
                                                 throws Exception {
    manager.add(createService()
      .setInterface(AudioBroadcaster.class.getName(), null)
      .setImplementation(AudioBroadcasterImpl.class));
      .add(createServiceDependency()
        .setService(AudioSource.class, null)
        .setRequired(true))
      .add(createServiceDependency()
        .setService(AudioEncoder.class, null)
        .setRequired(true))
      .add(createServiceDependency()
        .setService(LogService.class, null)
        .setRequired(false))
  }

  public void destroy(BundleContext ctx, DependencyManager manager)
                                                 throws Exception {
  }
}
```



```
public class Activator implements BundleActivator {
  private BundleContext context;
  private ServiceRegistration registration;
  private AudioBroadcaster audioBroadcaster;
  private AudioSource audioSource;
  private AudioEncoder audioEncoder;
  private ServiceTracker audioSourceTracker;
  private ServiceTracker audioEncoderTracker;
  private ServiceTracker logTracker;

  public void start(BundleContext context) throws Exception {
    this.context = context;
    audioSourceTracker = new ServiceTracker(context,
        AudioSource.class.getName(), customizer);
    audioEncoderTracker = new ServiceTracker(context,
        AudioEncoder.class.getName(), customizer);
    logTracker = new ServiceTracker(context, LogService.class.getName(),
        null);
    logTracker.open();
    audioSourceTracker.open();
    audioEncoderTracker.open();
  }

  public void stop(BundleContext context) throws Exception {
    audioSourceTracker.close();
    audioEncoderTracker.close();
    logTracker.close();
  }

  private ServiceTrackerCustomizer customizer =
      new ServiceTrackerCustomizer() {
    public Object addingService(ServiceReference reference) {
      Object service = context.getService(reference);
      setService(reference, service);
      return service;
    }

    private void setService(ServiceReference reference, Object service) {
      // update service references
      Object objectclass = reference.getProperty(Constants.OBJECTCLASS);
      if (objectclass instanceof String) {
        String name = (String) objectclass;
        setNamedService(service, name);
      }
      if (objectclass instanceof String[]) {
        String[] names = (String[]) objectclass;
        for (int i = 0; i < names.length; i++) {
          setNamedService(service, names[i]);
        }
      }

      // register service if necessary
      if ((registration == null) && (audioSource != null)
          && (audioEncoder != null)) {
        // instantiate the implementation and pass the services
        audioBroadcaster = new AudioBroadcasterImpl(audioSource,
        audioEncoder, logTracker);
        registration = context.registerService(
        AudioBroadcaster.class.getName(), audioBroadcaster, null);
      }

      // unregister service if necessary
      if (((audioSource == null) || (audioEncoder == null))
          && (registration != null)) {
        registration.unregister();
        registration = null;
    audioBroadcaster = null;
      }
    }

    private void setNamedService(Object service, String name) {
      if (AudioEncoder.class.getName().equals(name)) {
        audioEncoder = (AudioEncoder) service;
      }
      else if (AudioSource.class.getName().equals(name)) {
        audioSource = (AudioSource) service;
      }
    }

    public void modifiedService(ServiceReference reference,
        Object service) {
    }

    public void removedService(ServiceReference reference,
        Object service) {
      setService(reference, null);
      context.ungetService(reference);
    }
  };
}
```

Tracking dependencies

- Setting up a service with an optional dependency that can track multiple dependent services:

```
public class Activator extends DependencyActivatorBase {
  public void init(BundleContext bc, DependencyManager dm) {
    dm.add(createService()
      .setImplementation(DeviceTracker.class)
      .add(createServiceDependency()
        .setService(Device.class)
        .setAutoConfig(false)
        .setCallbacks("addDevice", "removeDevice")
        .setRequired(false))
      );
  }
  public void destroy(BundleContext bc, DependencyManager dm) {
  }
}
```

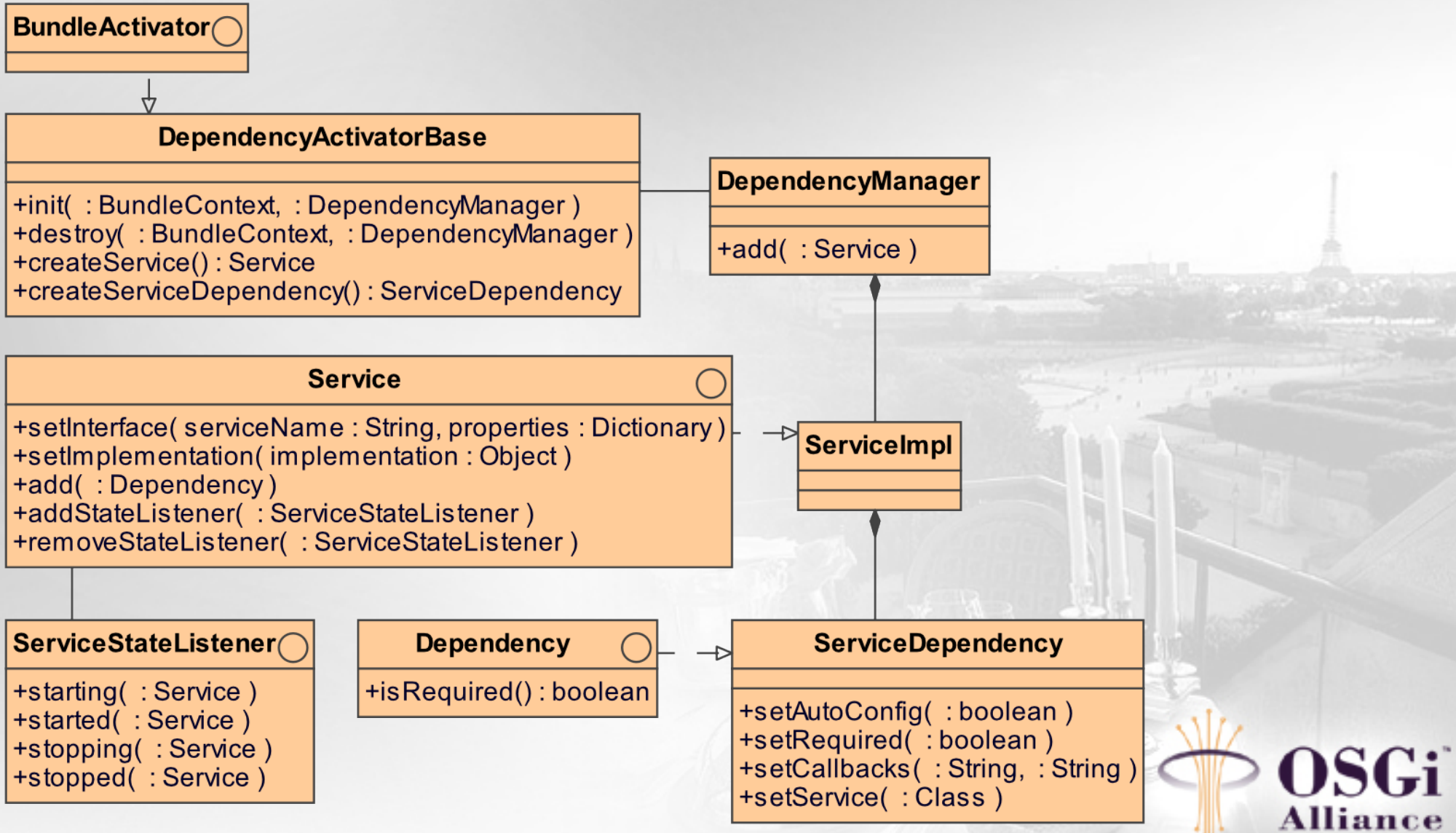
Tracking dependencies

- Implementation:

```
public class DeviceTracker {
  private List devs = new ArrayList();
  public void addDevice(ServiceReference ref, Object srv) {
    devs.add(srv);
  }
  public void removeDevice(ServiceReference ref, Object srv) {
    devs.remove(srv);
  }
}
```

OSGi Alliance

Architecture: class diagram



Other features:

- Injection of BundleContext and ServiceRegistration
- New services and dependencies can be added or removed dynamically
- Callbacks are configurable and will look for methods with “suitable” signatures
- Service listeners allow you to track the state of a service
- Manager allows for addition of customized dependencies (so you're not limited to service dependencies)

OSGi Alliance

Conclusions

- Clean separation between service implementation and dependency management, you can use a POJO if you want
- Dynamic nature of dependencies has proven to be useful in several scenarios
- Substantial code reduction is realized when compared to using service trackers

OSGi Alliance

Further info

- Contacting me:
  e-mail: marcel.offermans@luminis.nl
  ICQ: 22100024
  Skype: marcel_offermans
- Article:
  http://www.osgi.org/news_events/articles.asp?section=4
- Development site:
  https://opensource.luminis.net/confluence/x/PwE

OSGi Alliance