Pervasive Spontaneous Composition

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Outline

- Pervasive Computing
- Hiding complexity
- Realisation

Pervasive Computing

Pervasive Computing

Mark Weiser in the 90s

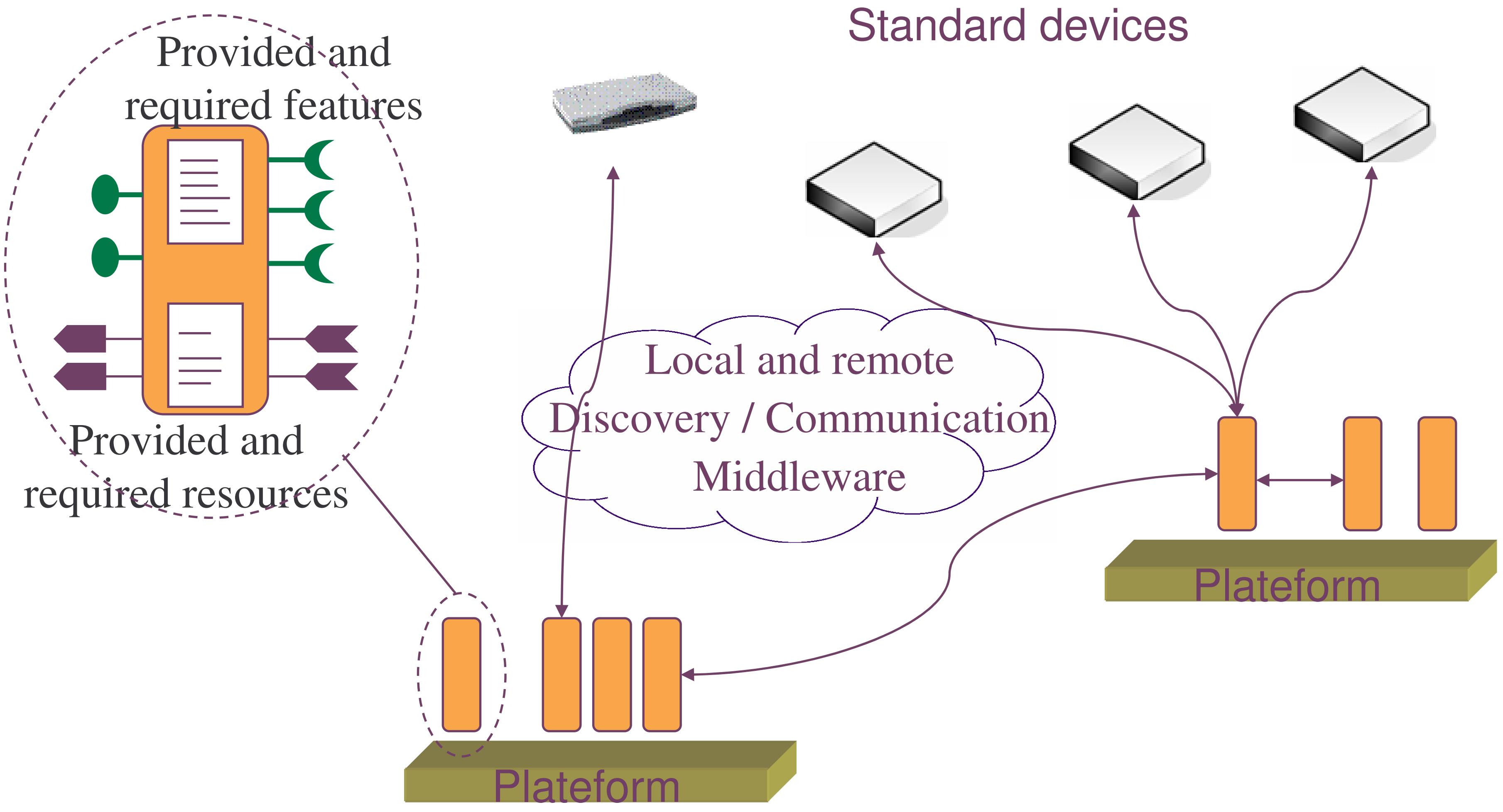
- Numerous and numerous smart networked devices
- Natural user interfaces

=> Fading into the background (the factory metaphor)

Interconnection and self-organisation

- Device discovery and description
- Distribution and mobility
- Location-awareness and context-awareness

Our Vision



Standard devices

Provided and required features

Provided and required resources

Local and remote Discovery / Communication Middleware

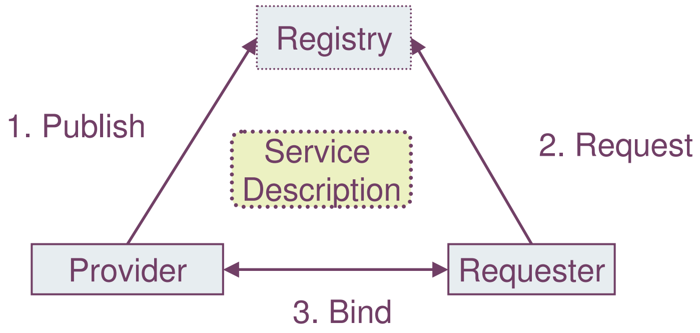
Software engineering

Object orientation

- Clear intracomponent architecture
- Evolutivity

Component orientation

- Clear architecture
- Separation of concerns



Service orientation

- Service abstraction above a component implementation
- Service discovery with provider/requester/registry model

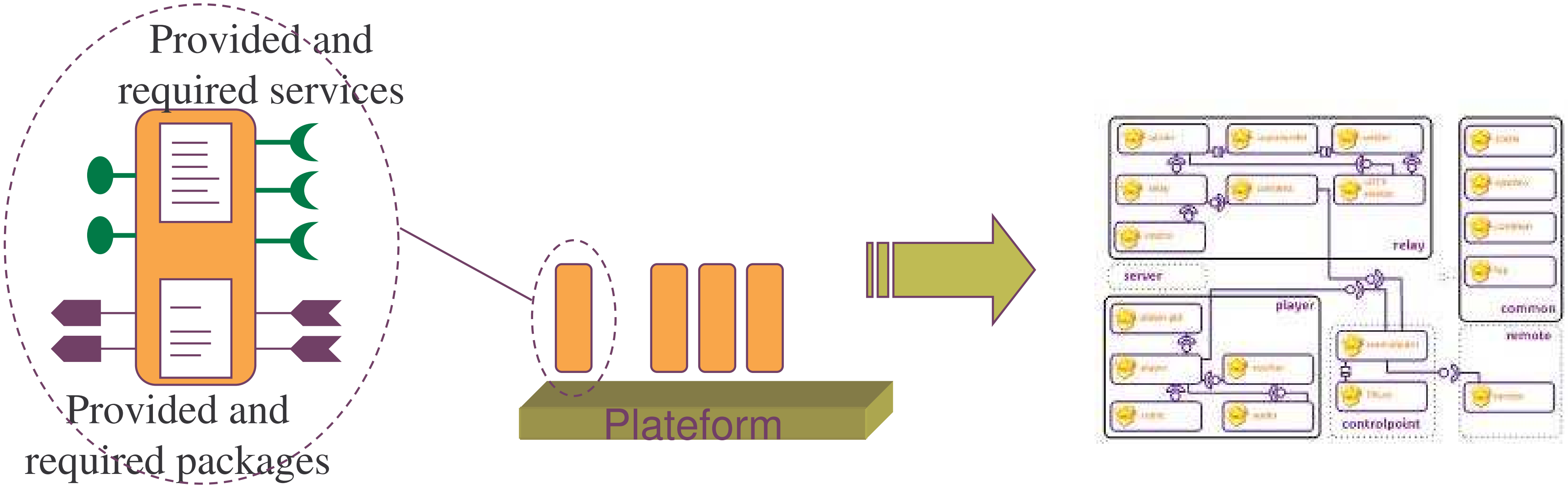
Hiding complexity

Hiding service availability management

OSGi R4 Declarative Services

- Fine grain component above OSGi bundle model
- Self-description: service dependency description

⇒Developers do not write error-prone code any more


Provided and required services
Provided and required packages
Plateform
relay
server
player
common
remote
controlpoint

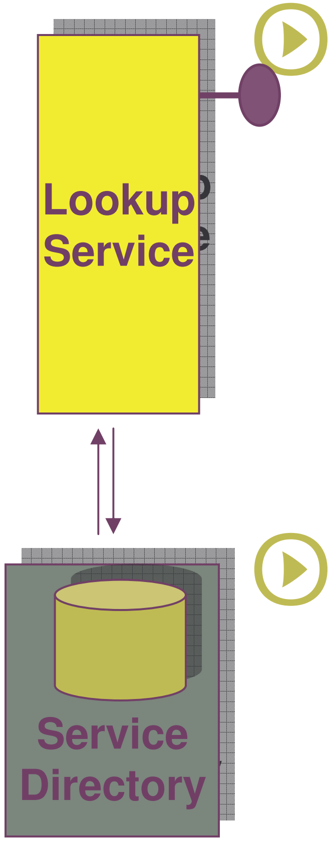
Hiding distributed protocol heterogeneity: Service Discovery protocols

- **Many existing technologies**
  - on IP networks
    - UPnP (SSDP, GENA, SOAP, etc)
    - Bonjour (DNS-SD, mDNS)
    - DPWS (SOAP, WSDL, ws-*)
    - IGRS (SSDP+, GENA+, SOAP, WSDL, etc.)
    - CORBA (IIOP, CORBA Services)
    - Jini
    - SLP
    - Salutation
    - …
  - And on ad hoc networks …
    - ZigBee
    - Bluetooth SDP
    - …

Hiding distributed protocol heterogeneity: Service Discovery protocol generic layers

- Addressing layer (e.g. DHCP, AutoIP)
- Naming layer (e.g. DNS, mDNS)
- Discovery layer (e.g. SSDP)
- Description layer (e.g. WSDL)
- Control layer (e.g. SOAP)
- Eventing layer (ws-eventing)
- High-level layers : Presentation, Security, QoS, etc.

Lookup Service



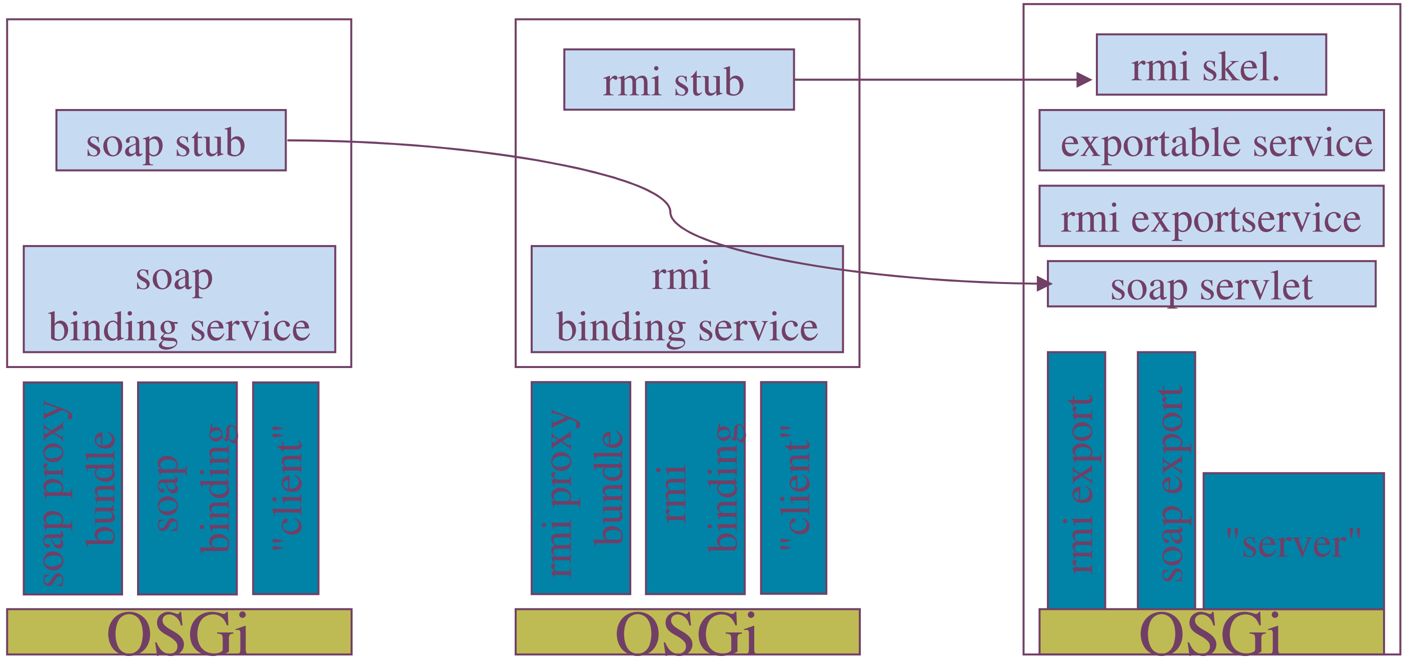
One unified interface to access external service directory

- String registerService(Service s)
- void unregisterService(String uuid)
- Service[] lookup(String interFace, String LDAPFilter)
- void addListener(RemoteServiceListener)

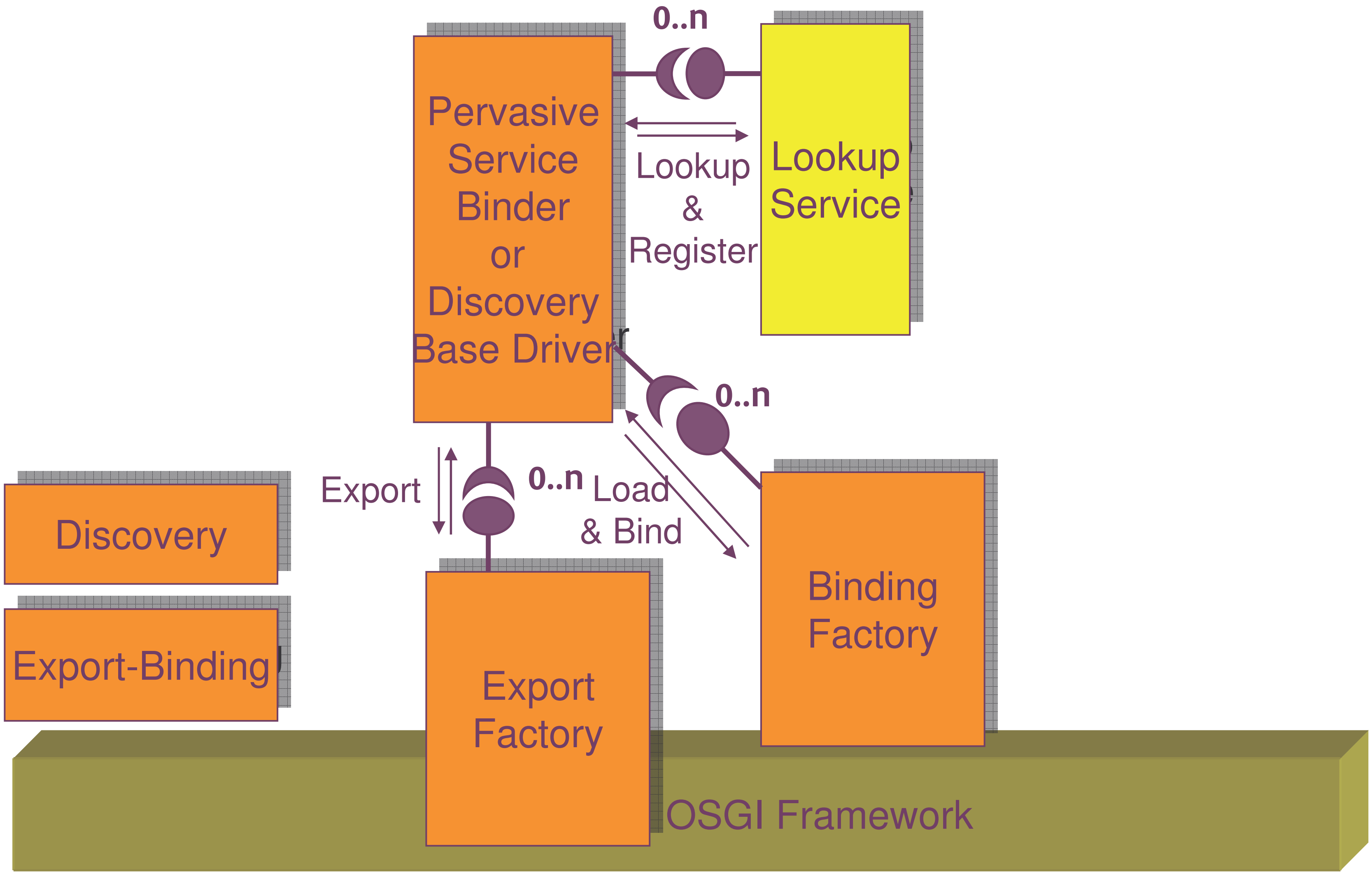
Various possible instances

SLPLookupService	Directory Agent or multicast requests
SSDPLookupService	multicast requests
WSDLookupService	Discovery Proxy or multicast requests
…	

Export / Binding



Discovery infrastructure



An extended Service Binder

Pervasive Service Oriented Middleware

- Adapt to dynamic service availability
- Adapt to Service Discovery protocol multiplicity
- Make the use of local and distant services transparent and keep priority on local binding

Technological choice and achievements

- OSGi R4 Declarative Services (Service Binder)
- Extension: distribution with standard protocols
  - Architecture with plugins (generic interfaces)
    - *Discovery: WS-Discovery, SSDP, SLP*
    - *Communication: SOAP, RMI*

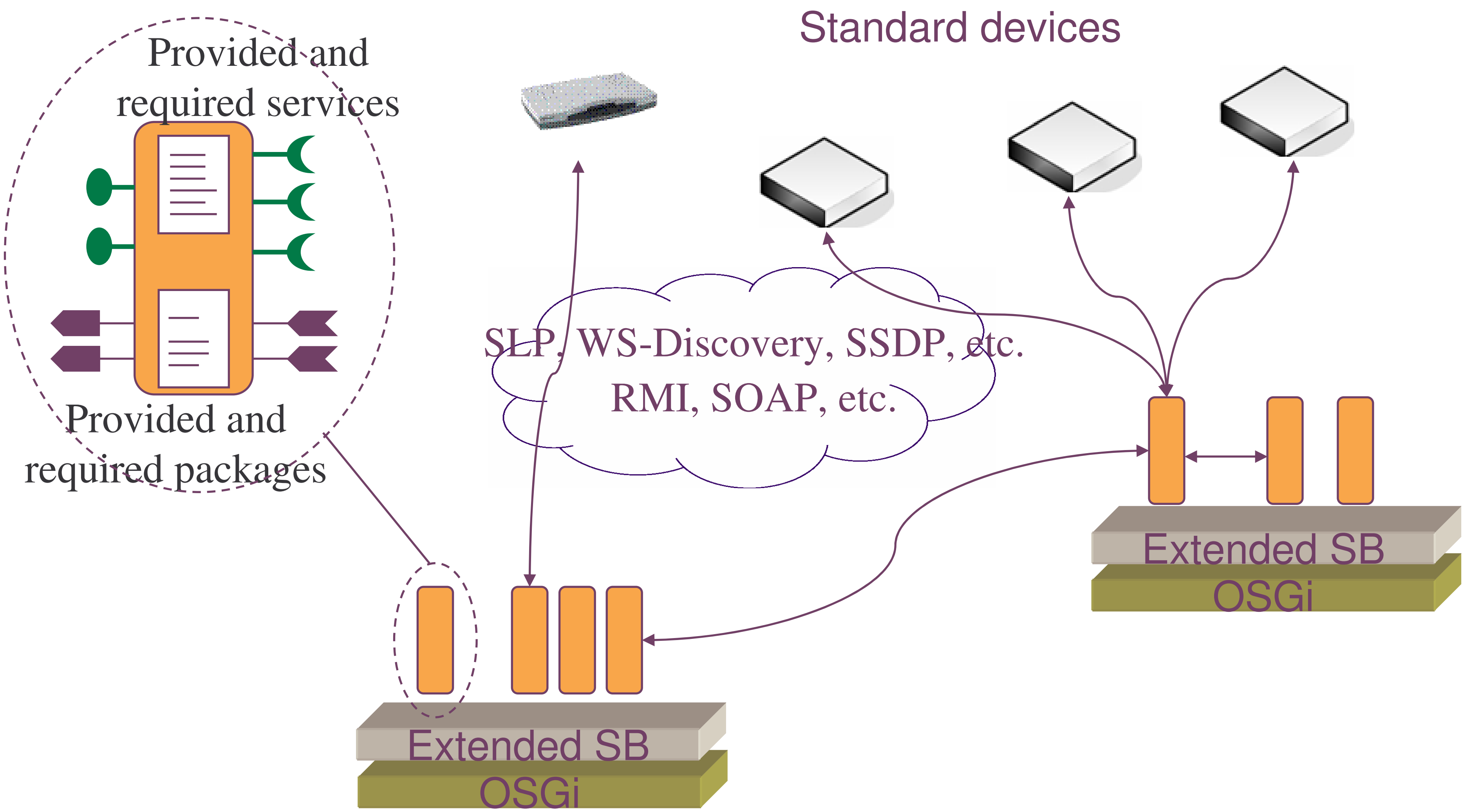
Declarative description

```
<?xml version="1.0" encoding="UTF-8"?>
<!--<!DOCTYPE bundle SYSTEM "metadata-amicom.dtd">-->
<bundle>
  <component class="com.francetelecom.amicom.app.AudioComposer">
    <requires service="com.francetelecom.AudioPlayer"
      filter="(location=*)"
      cardinality="1..1"
      policy="dynamic"
      bind-method="bindAudioPlayer"
      unbind-method="unbindAudioPlayer"
      local-only="false"
    />
  </component>
</bundle>
```

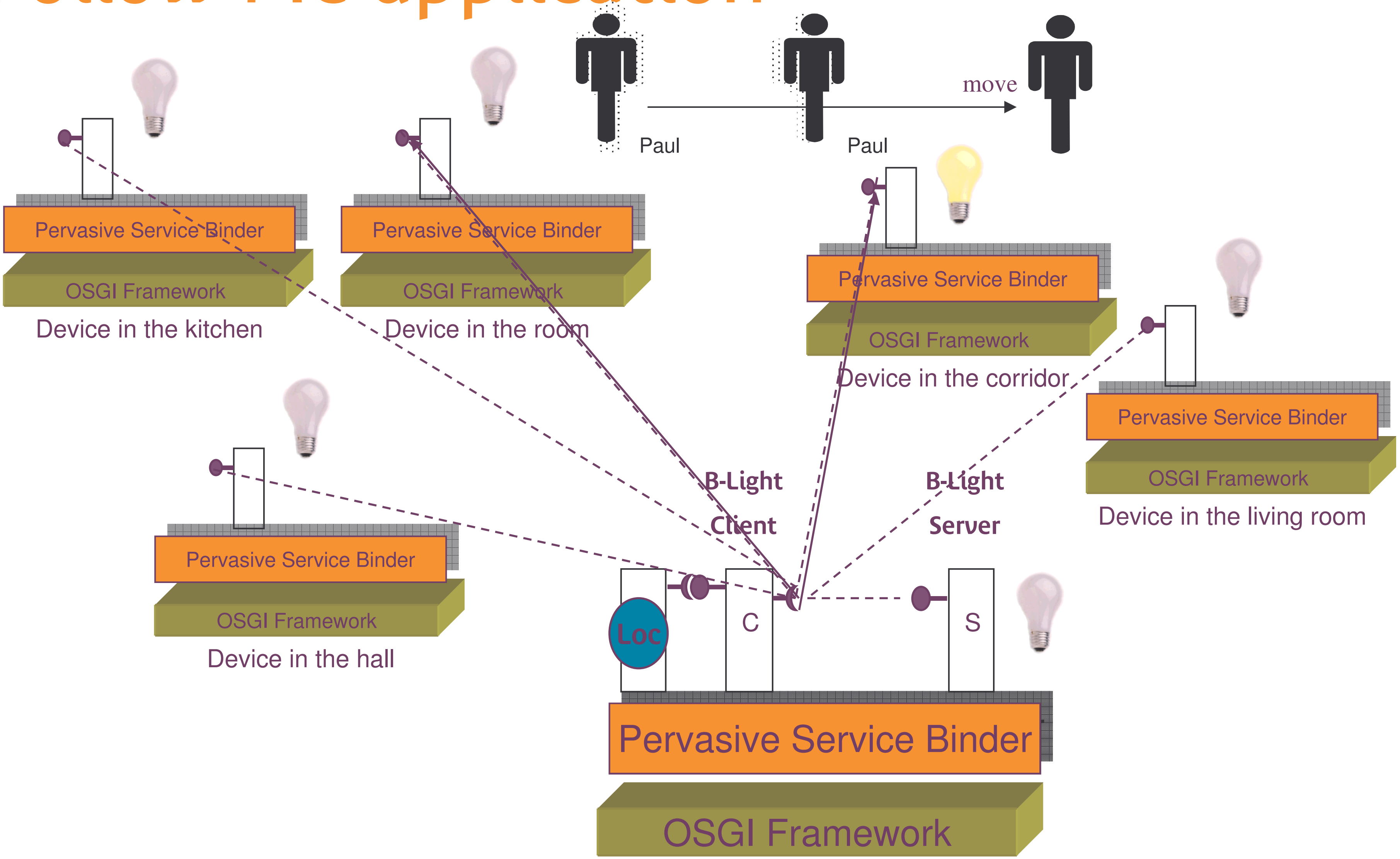
```
<?xml version="1.0" encoding="UTF-8"?>
<!--<!DOCTYPE bundle SYSTEM "metadata-amicom.dtd">-->
<bundle>
  <component class="com.francetelecom.amicom.impl.AudioPlayerImpl">
    <provides
        service="com.francetelecom.amicom.AudioPlayer"/>
    <property name="plateforme" value="g-babord" type="string"/>
    <onregister registry="*"/>
  </component>
</bundle>
```

Realisation

Technical architecture


Standard devices
Provided and required services
Provided and required packages
SLP, WS-Discovery, SSDP, etc.
RMI, SOAP, etc.
Extended SB
OSGi
Extended SB
OSGi

Follow-Me application



Acknoledgements

- RNRT Pise project

Thanks for your attention