

Which libSBML ?



libSBML-3.4.1

libSBML-4.0.1

libSBML-4.1.0

libSBML-5.0.0

libSBML-3.4.1



New users should NOT use

Current users PLEASE upgrade

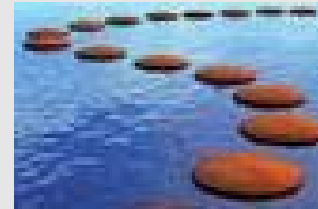


libSBML-3.4.1

- Bug fixes in later versions - validation
- Code not supported
- Does not support SBML L3

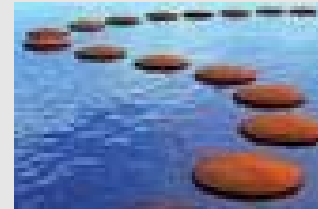
libSBML-4.0.1

- API changes from 3.4.1
- Fully stable release
- Does not support SBML L3



libSBML-4.1.0-b3

- Supports SBML L3 core EXCEPT
 - unit validation of L3 models
 - translation of L3 models to L2
 - documentation
- Build issues with more recent OS(es)
- WILL BE A STABLE RELEASE ASAP






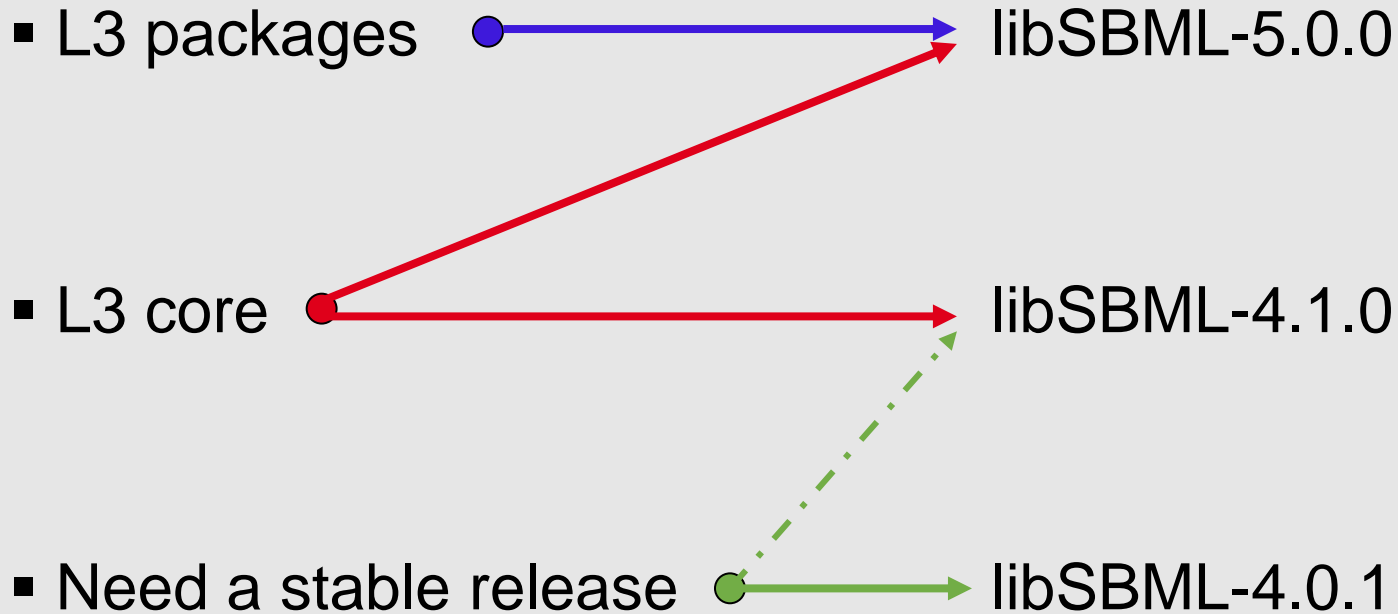


libSBML-5.0.0-a2

- Identical to 4.1.0
 - ONE API change
 - adds support for packages as extensions in C++
- WILL BE THE ONLY SUPPORTED VERSION

EVENTUALLY

So which libSBML ??

- L3 packages   libSBML-5.0.0
 - L3 core   libSBML-4.1.0
 - Need a stable release  libSBML-4.0.1
- 
- ```
graph LR; L3_packages((L3 packages)) -- blue arrow --> libSBML_5_0_0(libSBML-5.0.0); L3_core((L3 core)) -- red arrow --> libSBML_4_1_0(libSBML-4.1.0); L3_core -- red arrow --> libSBML_5_0_0; Need_stable((Need a stable release)) -- green arrow --> libSBML_4_0_1(libSBML-4.0.1); Need_stable -.-> libSBML_4_1_0;
```



# libSBML-5

How to write Level 3 packages extensions

Sarah Keating

(on behalf of Akiya Jouraku)



# SBML Level 3

possibly  
necessary

The Systems Biology Markup Language (SBML):  
Language Specification for Level 3 Version 1 Core

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[sbml-editors@sbml.org](mailto:sbml-editors@sbml.org)  
**core**  
SBML Level 3 Version 1 Core

Release 1 (Candidate)  
31 December 2009

Please report errors, ambiguities, and other issues in this document using the form at <http://sbml.org/specifications/sbml-level-3/version-1/core/issue-report-form>

Corrections and other changes to this SBML language specification may appear over time. Notifications of these changes are broadcast on the mailing list [sbml-announce@sbml.org](mailto:sbml-announce@sbml.org)

The latest release of the SBML Level 3 Version 1 Core specification is available at <http://sbml.org/specifications/sbml-level-3/version-1/core>

This release of the specification is available at <http://sbml.org/specifications/sbml-level-3/version-1/core/release-1/>

The list of known issues in all releases of SBML Level 3 Version 1 Core is available at <http://sbml.org/specifications/sbml-level-3/version-1/core/errata/>

Formal schemas for use with validators are available at <http://sbml.org/specifications/sbml-level-3/version-1/core/schemas/>

**spatial**

**comp**

**qual**

**layout**

Submodel 1 Submodel 2

A B

O

additional  
information

mathematically necessary for  
correct interpretation

# SBML Level 3

```
<sbml xmlns="http://www.sbml.org/sbml.level3/version1/core"
 xmlns:comp="http://www.sbml.org/sbml/level3/version1/comp/version1"
 comp:required="true"
 xmlns:qual="http://www.sbml.org/sbml/level3/version1/qual/version1"
 qual:required="true"
 xmlns:layout="http://www.sbml.org/sbml/level3/version1/layout/version1"
 layout:required="false"
 xmlns:spatial="http://www.sbml.org/sbml/level3/version1/spatial/version1"
 spatial:required="true"
```

# libSBML-5

libSBML core  
(very minor API changes from libSBML-4)

# libSBML-5

libSBML core  
(very minor API changes from libSBML-4)

```
typedef enum
{
 SBML_UNKNOWN

 , SBML_COMPARTMENT
 , SBML_COMPARTMENT_TYPE
 , SBML_CONSTRAINT
 , ...

} SBMLTypeCode_t;
```

# libSBML-5

libSBML core  
(very minor API changes from libSBML-4)

```
typedef enum
{
 SBML_UNKNOWN = 0

 , SBML_COMPARTMENT = 1
 , SBML_COMPARTMENT_TYPE = 2
 , SBML_CONSTRAINT = 3
 , ...

} SBMLTypeCode_t;
```

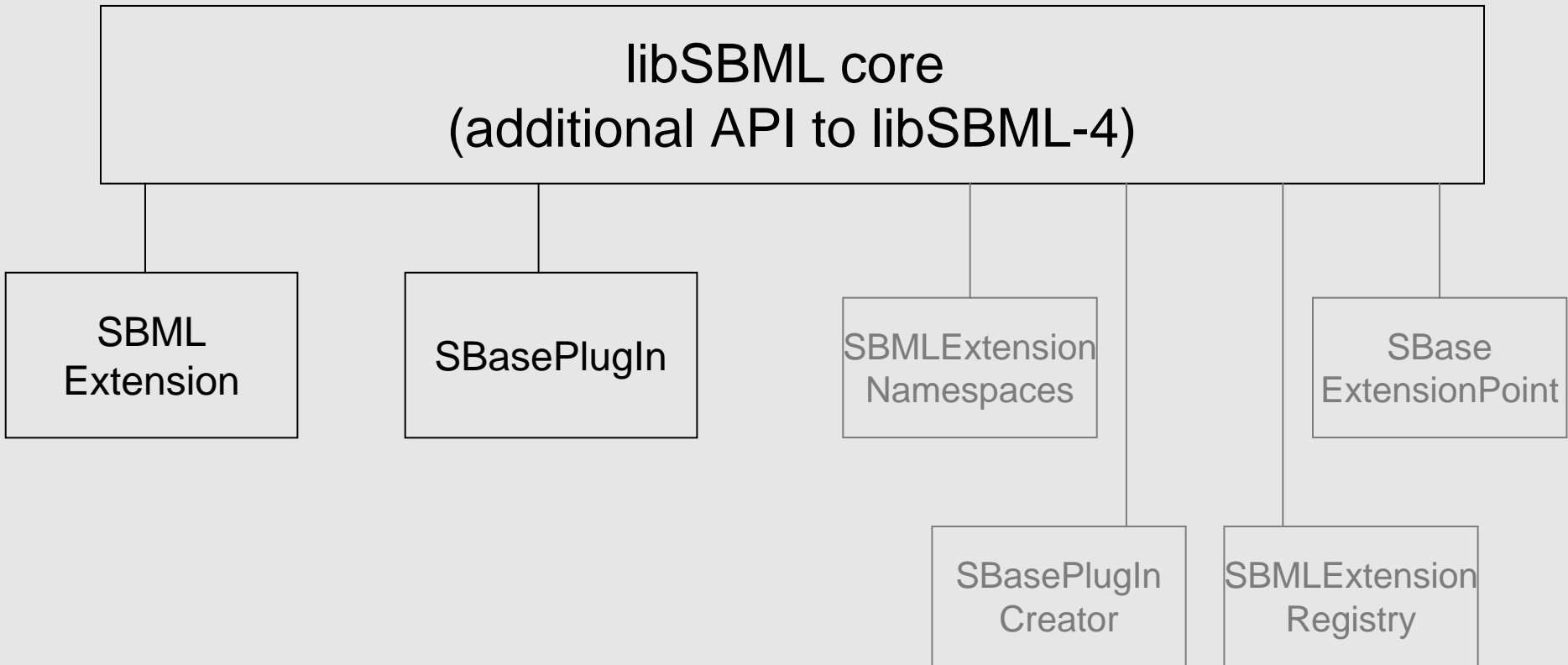
# libSBML-5

libSBML core  
(very minor API changes from libSBML-4)

SBMLTypeCode\_t getTypeCode()

int                   getTypeCode()

# libSBML-5





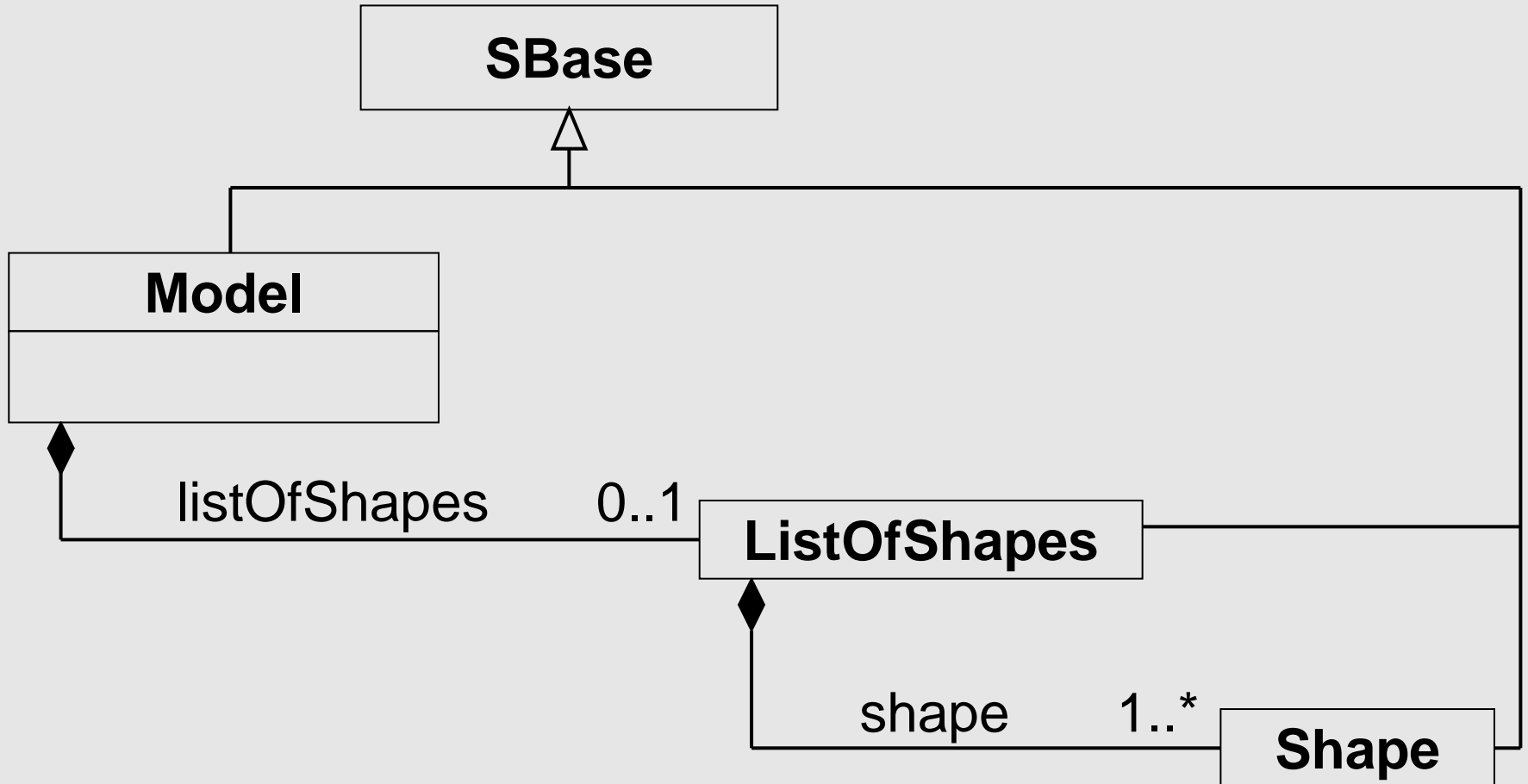
# Implementing a package

“appearance”

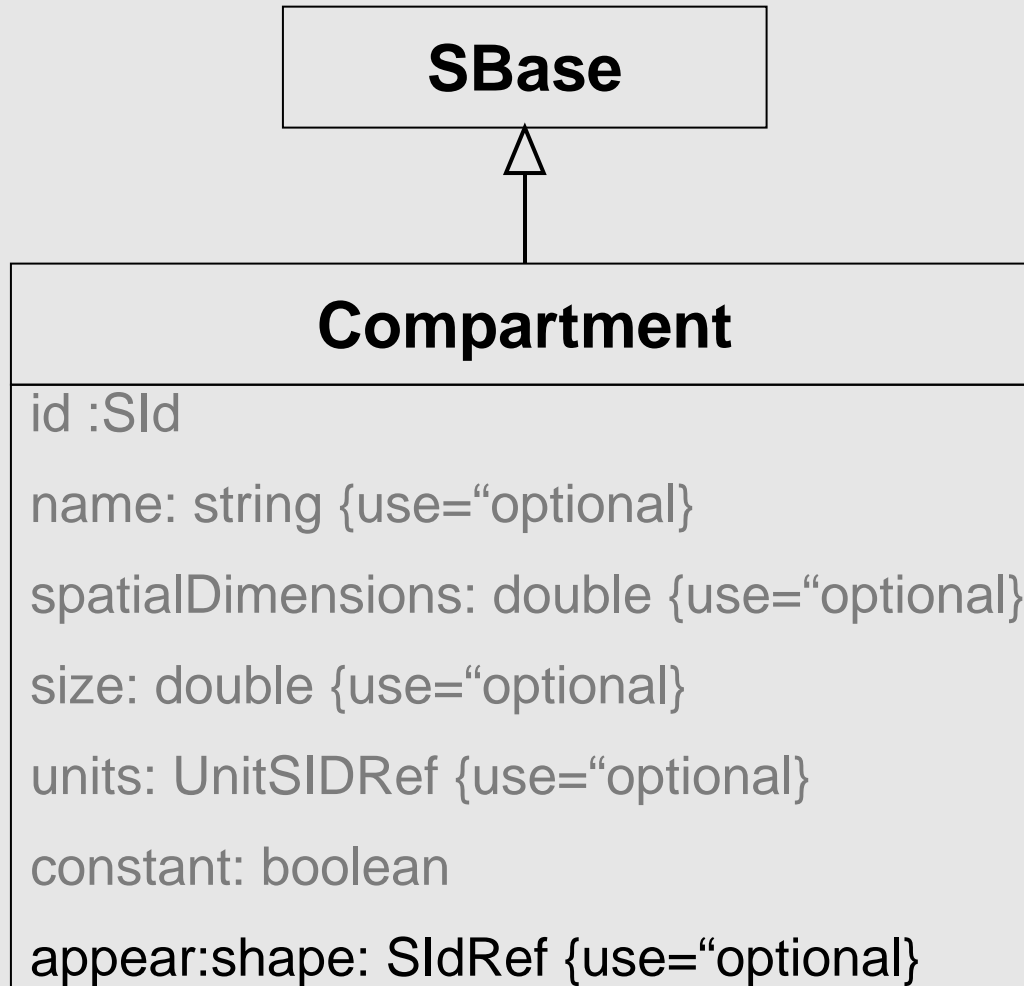
`xmlns:appear="http://www.sbml.org/sbml/level3/version1/appear/version1"`

`appear:required="false"`

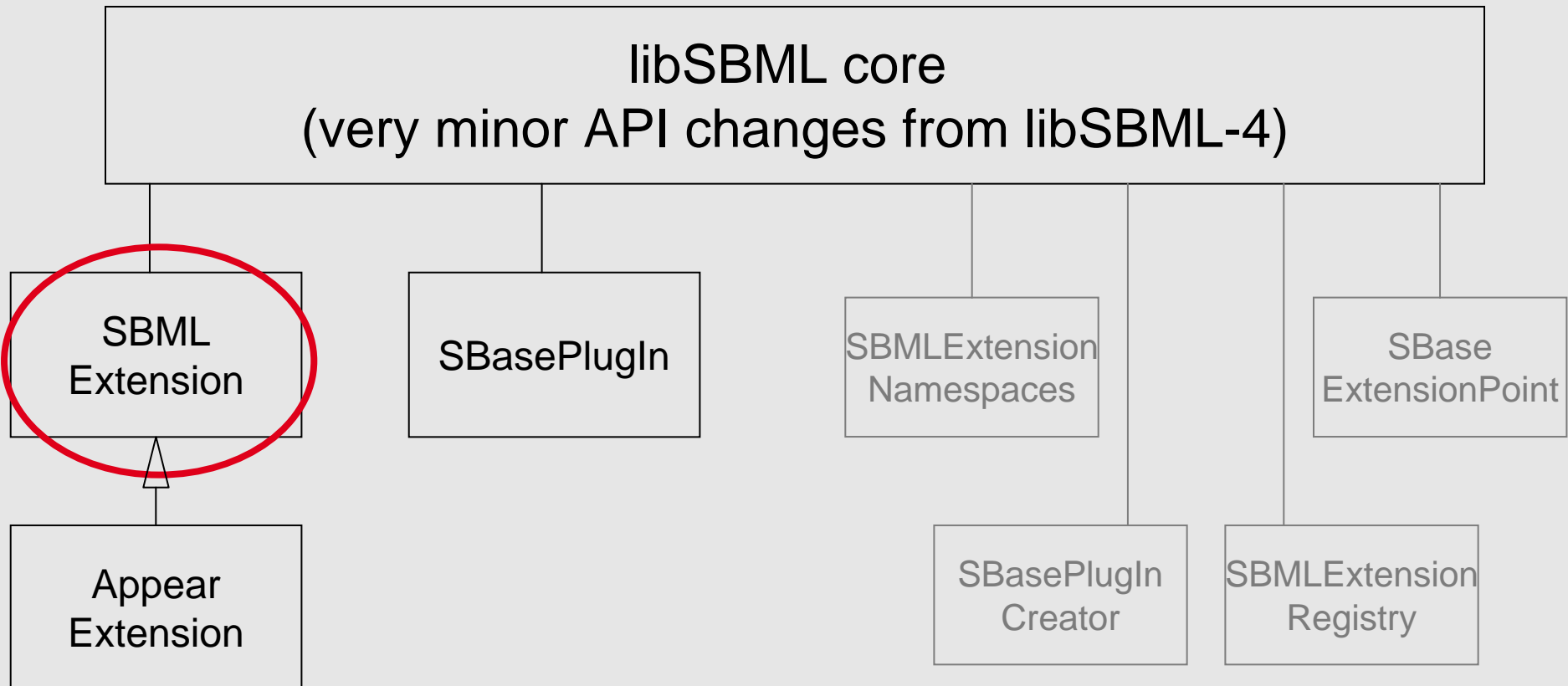
# Implementing a package



# Implementing a package



# Implementing a package



# Implementing a package

## 1. Create the Extension class

```
class AppearExtension : public SBMLExtension
{
};
```

# Implementing a package

## 1a. Define necessary variables

```
const std::string AppearExtension::PackageName = "appear"

const unsigned int AppearExtension ::DefaultLevel = 3;
const unsigned int AppearExtension ::DefaultVersion = 1;
const unsigned int AppearExtension ::DefaultPackageVersion = 1;

const std::string AppearExtension::XmlnsL3V1V1 =
 "http://www.sbml.org/sbml/level3/version1/appear/version1";
```

# Implementing a package

## 1b. Define necessary functions

```
virtual AppearExtension* clone () const;

virtual unsigned int getPackageVersion(const std::string &uri) const;

virtual SBMLNamespaces* getSBMLExtensionNamespaces(
 const std::string &uri) const;

static void init();
```

# Implementing a package

## 1c. Define the init() function

```
void

AppearExtension::init()
{
 AppearExtension appearExtension;
 std::vector<std::string> packageURIs;
 packageURIs.push_back(XmlnsL3V1V1);
 SBaseExtensionPoint sbmlDocExtPoint("core", SBML_DOCUMENT);
 SBaseExtensionPoint modelExtPoint("core", SBML_MODEL);
 SBaseExtensionPoint compExtPoint("core", SBML_COMPARTMENT);
 SBasePluginCreator<SBMLDocumentPlugin, AppearExtension> sbmlDocPluginCreator(sbmlDocExtPoint, packageURIs);
 SBasePluginCreator<AppearModelPlugin, AppearExtension > modelPluginCreator(modelExtPoint, packageURIs);
 SBasePluginCreator<AppearCompartmentPlugin, AppearExtension> compPluginCreator(compExtPoint, packageURIs);
 appearExtension.addSBasePluginCreator(&sbmlDocPluginCreator);
 appearExtension.addSBasePluginCreator(&modelPluginCreator);
 appearExtension.addSBasePluginCreator(&compPluginCreator);

 int result = SBMLExtensionRegistry::getInstance().addExtension(&appearExtension);

 if (result != LIBSBML_OPERATION_SUCCESS)
 {
 std::cerr << "[Error] AppearExtension::init() failed." << std::endl;
 }
}
```



# Implementing a package

## 1c. Define the init() function

```
void
AppearExtension::init()
{
 if (SBMLExtensionRegistry::getInstance().isRegistered(PackageName))
 {
 return;
 }
 std::vector<std::string> packageURIs;
 packageURIs.push_back(XmlnsL3V1V1);
 SBASEExtensionPoint sbmlDocExtPoint("core", SBML_DOCUMENT);
 SBASEExtensionPoint modelExtPoint("core", SBML_MODEL);
 SBASEExtensionPoint compExtPoint("core", SBML_COMPARTMENT);
 SBASEPluginCreator<SBMLDocumentPlugin, AppearExtension> sbmlDocPluginCreator(sbmlDocExtPoint, packageURIs);
 SBASEPluginCreator<AppearModelPlugin, AppearExtension > modelPluginCreator(modelExtPoint, packageURIs);
 SBASEPluginCreator<AppearCompartmentPlugin, AppearExtension> compPluginCreator(compExtPoint, packageURIs);
 appearExtension.addSBASEPluginCreator(&sbmlDocPluginCreator);
 appearExtension.addSBASEPluginCreator(&modelPluginCreator);
 appearExtension.addSBASEPluginCreator(&compPluginCreator);

 int result = SBMLExtensionRegistry::getInstance().addExtension(&appearExtension);

 if (result != LIBSBML_OPERATION_SUCCESS)
 {
 std::cerr << "[Error] AppearExtension::init() failed." << std::endl;
 }
}
```

# Implementing a package

## 1c. Define the init() function

```
void
AppearExtension::init()
{
 if (SBMLExtensionRegistry::getInstance().isRegistered(PackageName))
 {
 return;
 }

 AppearExtension appearExtension;
 std::vector<std::string> packageURIs;
 packageURIs.push_back(XmlnsL3V1V1);
 SBASEExtensionPoint sbmlDocExtPoint("core", SBML_DOCUMENT);
 SBASEExtensionPoint modelExtPoint("core", SBML_MODEL);
 SBASEExtensionPoint compExtPoint("core", SBML_COMPARTMENT);
 SBASEPluginCreator<SBMLDocumentPlugin, AppearExtension> sbmlDocPluginCreator(sbmlDocExtPoint, packageURIs);
 SBASEPluginCreator<AppearModelPlugin, AppearExtension > modelPluginCreator(modelExtPoint, packageURIs);
 SBASEPluginCreator<AppearCompartmentPlugin, AppearExtension> compPluginCreator(compExtPoint, packageURIs);
 appearExtension.addSBASEPluginCreator(&sbmlDocPluginCreator);
 appearExtension.addSBASEPluginCreator(&modelPluginCreator);
 appearExtension.addSBASEPluginCreator(&compPluginCreator);

 int result = SBMLExtensionRegistry::getInstance().addExtension(&appearExtension);

 if (result != LIBSBML_OPERATION_SUCCESS)
 {
 std::cerr << "[Error] AppearExtension::init() failed." << std::endl;
 }
}
```

# Implementing a package

## 1c. Define the init() function

```
void
AppearExtension::init()
{
 if (SBMLExtensionRegistry::getInstance().isRegistered(PackageName))
 {
 return;
 }

 AppearExtension appearExtension;

 std::vector<std::string> packageURIs;
 packageURIs.push_back(XmlInsl3V1V1);

 SBaseExtensionPoint docExtPoint("core", SBML_DOCUMENT);
 SBaseExtensionPoint compExtPoint("core", SBML_COMPARTMENT);
 SBasePluginCreator<SBMLDocumentPlugin, AppearExtension> sbmlDocPluginCreator(sbmlDocExtPoint, packageURIs);
 SBasePluginCreator<AppearModelPlugin, AppearExtension > modelPluginCreator(modelExtPoint, packageURIs);
 SBasePluginCreator<AppearCompartmentPlugin, AppearExtension> compPluginCreator(compExtPoint, packageURIs);
 appearExtension.addSBasePluginCreator(&sbmlDocPluginCreator);
 appearExtension.addSBasePluginCreator(&modelPluginCreator);
 appearExtension.addSBasePluginCreator(&compPluginCreator);

 int result = SBMLExtensionRegistry::getInstance().addExtension(&appearExtension);

 if (result != LIBSBML_OPERATION_SUCCESS)
 {
 std::cerr << "[Error] AppearExtension::init() failed." << std::endl;
 }
}
```

might want to  
include other  
namespaces

# Implementing a package

## 1c. Define the init() function

```
void
AppearExtension::init()
{
 if (SBMLExtensionRegistry::getInstance().isRegistered(PackageName))
 {
 return;
 }

 AppearExtension appearExtension;
 std::vector<std::string> packageURIs;
 packageURIs.push_back(XmlnsL3V1V1);

 SBaseExtensionPoint sbmlDocExtPoint("core", SBML_DOCUMENT);
 SBaseExtensionPoint modelExtPoint("core", SBML_MODEL);
 SBaseExtensionPoint compExtPoint("core", SBML_COMPARTMENT);
 SBasePluginCreator<SBMLDocumentPlugin, AppearExtension> sbmlDocPluginCreator(sbmlDocExtPoint, packageURIs);
 SBasePluginCreator<SBMLModelPlugin, AppearExtension> modelPluginCreator(modelExtPoint, packageURIs);
 SBasePluginCreator<SBMLCompartmentPlugin, AppearExtension> compPluginCreator(compExtPoint, packageURIs);
 appearExtension.addSBasePluginCreator(&sbmlDocPluginCreator);
 appearExtension.addSBasePluginCreator(&modelPluginCreator);
 appearExtension.addSBasePluginCreator(&compPluginCreator);

 int result = SBMLExtensionRegistry::getInstance().addExtension(&appearExtension);

 if (result != LIBSBML_OPERATION_SUCCESS)
 {
 std::cerr << "[Error] AppearExtension::init() failed." << std::endl;
 }
}
```

# Implementing a package

## 1c. Define the init() function

```
void
AppearExtension::init()
{
 if (SBMLExtensionRegistry::getInstance().isRegistered(PackageName))
 {
 return;
 }

 AppearExtension appearExtension;
 std::vector<std::string> packageURIs;
 packageURIs.push_back(XmlnsL3V1V1);

 SBaseExtensionPoint sbmlDocExtPoint("core", SBML_DOCUMENT);
 SBaseExtensionPoint modelExtPoint("core", SBML_MODEL);
 SBaseExtensionPoint compExtPoint("core", SBML_COMPARTMENT);

 SBasePluginCreator<SBMLDocumentPlugin, AppearExtension> sbmlDocPluginCreator(s, packageURIs);
 SBasePluginCreator<SBMLModelPlugin, AppearExtension> modelPluginCreator(s, packageURIs);
 SBasePluginCreator<SBMLCompartmentPlugin, AppearExtension> compPluginCreator(s, packageURIs);

 appearExtension.addSBasePluginCreator(&sbmlDocPluginCreator);
 appearExtension.addSBasePluginCreator(&modelPluginCreator);
 appearExtension.addSBasePluginCreator(&compPluginCreator);

 int result = SBMLExtensionRegistry::getInstance().addExtension(&appearExtension);

 if (result != LIBSBML_OPERATION_SUCCESS)
 {
 std::cerr << "[Error] AppearExtension::init() failed." << std::endl;
 }
}
```

adding  
'required'  
attribute

# Implementing a package

## 1c. Define the init() function

```
void
AppearExtension::init()
{
 if (SBMLExtensionRegistry::getInstance().isRegistered(PackageName))
 {
 return;
 }

 AppearExtension appearExtension;
 std::vector<std::string> packageURIs;
 packageURIs.push_back(XmlnsL3V1V1);

 SBaseExtensionPoint sbmlDocExtPoint("core", SBML_DOCUMENT);
 SBaseExtensionPoint modelExtPoint("core", SBML_MODEL);
 SBaseExtensionPoint compExtPoint("core", SBML_COMPARTMENT);

 SBasePluginCreator<SBMLDocumentPlugin, AppearExtension> sbmlDocPluginCreator(
 SBML_DOCUMENT_URI, packageURIs);
 SBasePluginCreator<SBMLModelPlugin, AppearExtension> modelPluginCreator(
 SBML_MODEL_URI, packageURIs);
 SBasePluginCreator<SBMLCompartmentPlugin, AppearExtension> compPluginCreator(
 SBML_COMPARTMENT_URI, packageURIs);
 appearExtension.addSBasePluginCreator(&sbmlDocPluginCreator);
 appearExtension.addSBasePluginCreator(&modelPluginCreator);
 appearExtension.addSBasePluginCreator(&compPluginCreator);

 int result = SBMLExtensionRegistry::getInstance().addExtension(&appearExtension);

 if (result != LIBSBML_OPERATION_SUCCESS)
 {
 std::cerr << "[Error] AppearExtension::init() failed." << std::endl;
 }
}
```

adding  
'ListOfShapes'  
element

# Implementing a package

## 1c. Define the init() function

```
void
AppearExtension::init()
{
 if (SBMLExtensionRegistry::getInstance().isRegistered(PackageName))
 {
 return;
 }

 AppearExtension appearExtension;
 std::vector<std::string> packageURIs;
 packageURIs.push_back(XmlnsL3V1V1);

 SBaseExtensionPoint sbmlDocExtPoint("core", SBML_DOCUMENT);
 SBaseExtensionPoint modelExtPoint("core", SBML_MODEL);
 SBaseExtensionPoint compExtPoint("core", SBML_COMPARTMENT);
 SBasePluginCreator<SBMLDocument> plugin_AppearExtension(&sbmlDocExtPoint, packageURIs);
 SBasePluginCreator<SBMLModel> plugin_ModelAppearExtension(&modelExtPoint, packageURIs);
 SBasePluginCreator<SBMLCompartment> plugin_CompartmentAppearExtension(&compExtPoint, packageURIs);
 appearExtension.addSBasePluginCreator(&sbmlDocPluginCreator);
 appearExtension.addSBasePluginCreator(&modelPluginCreator);
 appearExtension.addSBasePluginCreator(&compPluginCreator);

 int result = SBMLExtensionRegistry::getInstance().registerExtension(appearExtension);

 if (result != LIBSBML_OPERATION_SUCCESS)
 {
 std::cerr << "[Error] AppearExtension failed to register." << std::endl;
 }
}
```

adding 'shape'  
attribute

# Implementing a package

## 1c. Define the init() function

```
void
AppearExtension::init()
{
 if (SBMLExtensionRegistry::getInstance().isRegistered(PackageName))
 {
 return;
 }

 AppearExtension appearExtension;
 std::vector<std::string> packageURIs;
 packageURIs.push_back(XmlnsL3V1V1);

 SBaseExtensionPoint sbmlDocExtPoint("core", SBML_DOCUMENT);
 SBaseExtensionPoint modelExtPoint("core", SBML_MODEL);
 SBaseExtensionPoint compExtPoint("core", SBML_COMPARTMENT);

 SBasePluginCreator<SBMLDocument> pluginDoc(&sbmlDocExtPoint, packageURIs);
 SBasePluginCreator<SBMLModel> pluginModel(&modelExtPoint, packageURIs);
 SBasePluginCreator<SBMLCompartment> pluginComp(&compExtPoint, packageURIs);
 appearExtension.addSBasePluginCreator(&pluginDoc);
 appearExtension.addSBasePluginCreator(&pluginModel);
 appearExtension.addSBasePluginCreator(&pluginComp);

 int result = SBMLExtensionRegistry::getInstance().addExtension(&appearExtension);

 if (result != LIBSBML_OPERATION_SUCCESS)
 {
 std::cerr << "[Error] AppearExtension::init() failed." << std::endl;
 }
}
```

could be  
another  
package name



# Implementing a package

## 1c. Define the init() function

```
void
AppearExtension::init()
{
 if (SBMLExtensionRegistry::getInstance().isRegistered(PackageName))
 {
 return;
 }

 SBasePluginCreator<SBMLDocumentPlugin, AppearExtension>
 sbmlDocPluginCreator(sbmlDocExtPoint,packageURIs);

 SBasePluginCreator<AppearModelPlugin, AppearExtension>
 modelPluginCreator(modelExtPoint,packageURIs);

 SBasePluginCreator<AppearCompartmentPlugin, AppearExtension>
 compPluginCreator(compExtPoint,packageURIs);
}

int result = SBMLExtensionRegistry::getInstance().addExtension(&appearExtension);
if (result != LIBSBML_OPERATION_SUCCESS)
{
 std::cerr << "[Error] AppearExtension::init() failed." << std::endl;
}
}
```

# Implementing a package

## 1c. Define the init() function

```
void
AppearExtension::init()
{
 if (SBMLExtensionRegistry::getInstance().isRegistered(PackageName))
 {
 return;
 }

 AppearExtension appearExtension;

 std::vector<std::string> packageURIs;
 packageURIs.push_back(XmlnsL3V1V1);
 SBASEExtensionPoint sbmlDocExtPoint("core", SBML_DOCUMENT);
 SBASEExtensionPoint modelExtPoint("core", SBML_MODEL);
 SBASEExtensionPoint compExtPoint("core", SBML_COMPARTMENT);
 SBASEPluginCreator<SBMLDocumentPlugin, AppearExtension> sbmlDocPluginCreator(sbmlDocExtPoint, packageURIs);
 SBASEPluginCreator<AppearModelPlugin, AppearExtension > modelPluginCreator(modelExtPoint, packageURIs);
 SBASEPluginCreator<AppearCompartmentPlugin, AppearExtension> compPluginCreator(compExtPoint, packageURIs);
 appearExtension.addSBASEPluginCreator(&sbmlDocPluginCreator);
 appearExtension.addSBASEPluginCreator(&modelPluginCreator);
 appearExtension.addSBASEPluginCreator(&compPluginCreator);
 int result = SBMLExtensionRegistry::getInstance().addExtension(&appearExtension);
 if (result != LIBSBML_OPERATION_SUCCESS)
 {
 std::cerr << "[Error] AppearExtension::init() failed." << std::endl;
 }
}
```

# Implementing a package

## 1c. Define the init() function

```
void
AppearExtension::init()
{
 if (SBMLExtensionRegistry::getInstance().isRegistered(PackageName))
 {
 return;
 }

 AppearExtension appearExtension;

 std::vector<std::string> packageURIs;
 packageURIs.push_back(XmlnsL3V1V1);
 SBaseExtensionPoint sbmlDocExtPoint("core", SBML_DOCUMENT);
 SBaseExtensionPoint modelExtPoint("core", SBML_MODEL);
 SBaseExtensionPoint compExtPoint("core", SBML_COMPARTMENT);
 SBaseExtensionPoint sbmlDocPluginExtPoint("core", SBML_DOCUMENT_PLUGIN);
 SBaseExtensionPoint modelPluginExtPoint("core", SBML_MODEL_PLUGIN);
 SBaseExtensionPoint compPluginExtPoint("core", SBML_COMPARTMENT_PLUGIN);
 SBaseExtensionPoint sbmlDocPluginCreatorExtPoint("core", SBML_DOCUMENT_PLUGIN_CREATOR);
 SBaseExtensionPoint modelPluginCreatorExtPoint("core", SBML_MODEL_PLUGIN_CREATOR);
 SBaseExtensionPoint compPluginCreatorExtPoint("core", SBML_COMPARTMENT_PLUGIN_CREATOR);

 int result = SBMLDocumentPluginCreator(sbmlDocExtPoint, packageURIs);
 SBMLExtensionRegistry::getInstance().addExtension(&appearExtension);
 appearExtension.addSBasePluginCreator(&sbmlDocPluginCreator);
 appearExtension.addSBasePluginCreator(&modelPluginCreator);
 appearExtension.addSBasePluginCreator(&compPluginCreator);
 if (result != LIBSBML_OPERATION_SUCCESS)
 {
 std::cerr << "[Error] AppearExtension::init() failed." << std::endl;
 }
}
```

# Implementing a package

## 1d. Necessary type definitions

```
typedef SBMLExtensionNamespaces<AppearExtension>
 AppearPkgNamespaces;
```

```
typedef enum
{
 SBML_APPEAR_SHAPE = 200
} SBMLAppearTypeCode_t;
```

```
SBML_COMPARTMENT
SBML_LAYOUT_CURVE
SBML_GROUPS_MEMBER
```

# Implementing a package

## 2. Create the PlugIn classes

```
void
AppearExtension::init()
{
 if (SBMLExtensionRegistry::getInstance().isRegistered(PackageName))
 {
 return;
 }

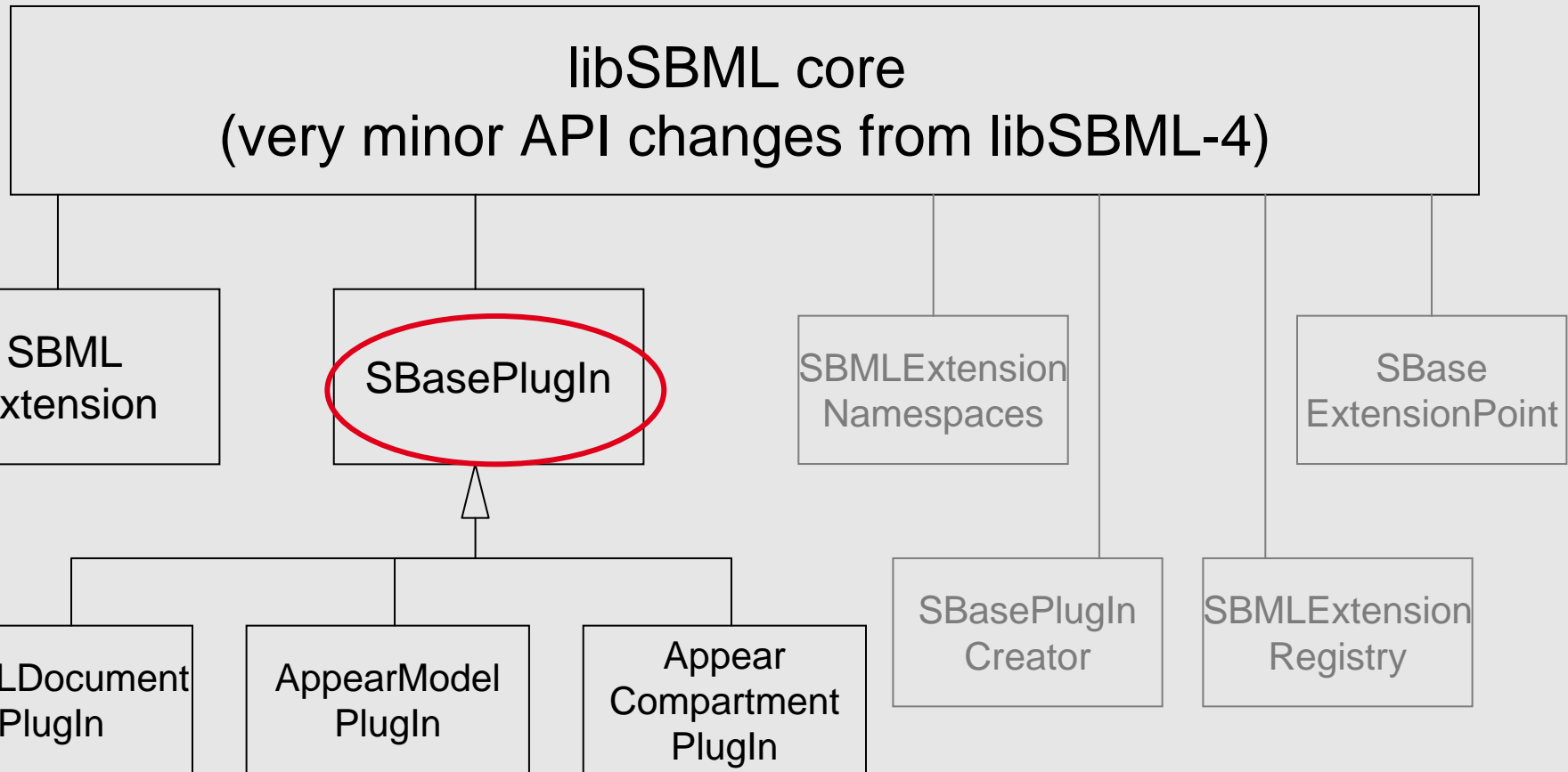
 SBBasePluginCreator<SBMLDocumentPlugin, AppearExtension>
 sbmlDocPluginCreator(sbmlDocExtPoint,packageURIs);

 SBBasePluginCreator<AppearModelPlugin, AppearExtension>
 modelPluginCreator(modelExtPoint,packageURIs);

 SBBasePluginCreator<AppearCompartmentPlugin, AppearExtension>
 compPluginCreator(compExtPoint,packageURIs);
}

int main = SBMLExtensionRegistry::getInstance().addExtension(&appearExtension);
if (result != LIBSBML_OPERATION_SUCCESS)
{
 std::cerr << "[Error] AppearExtension::init() failed." << std::endl;
}
}
```

# Implementing a package



# Implementing a package

## 2a. CompartmentPlugIn class

```
class AppearCompartmentPlugIn : public SBasePlugIn
{
public:
 AppearCompartmentPlugIn (const std::string &uri, const std::string &prefix, SBMLNamespaces *sbmlns);
 AppearCompartmentPlugIn(const AppearCompartmentPlugIn& orig);
 virtual ~AppearCompartmentPlugIn ();
 AppearCompartmentPlugIn& operator=(const AppearCompartmentPlugIn& orig);
 virtual AppearCompartmentPlugIn* clone () const;
 virtual void addExpectedAttributes(ExpectedAttributes& attributes);
 virtual void readAttributes (const XMLAttributes& attributes,
 const ExpectedAttributes& expectedAttributes);
 virtual void writeAttributes (XMLOutputStream& stream) const;
 std::string getShape() const;
 int setShape(std::string value);

protected:
 std::string mShape;
};
```

# Implementing a package

## 2a. CompartmentPlugin class

```
class AppearCompartmentPlugin : public SBasePlugin
{
public:
 AppearCompartmentPlugin (const std::string &uri,
 const std::string &prefix, SBMLNamespaces *sbmlns);
 AppearCompartmentPlugin(const AppearCompartmentPlugin& orig);
 virtual void addExpectedAttributes(ExpectedAttributes& attributes);
 virtual ~AppearCompartmentPlugin ();
 AppearCompartmentPlugin& operator=(const
 AppearCompartmentPlugin& orig);
 std::string getShape() const;
 int setShape(std::string value);
 virtual AppearCompartmentPlugin* clone () const;
protected:
 std::string mShape;
};
```



# Implementing a package

## 2a. CompartmentPlugIn class

```
class AppearCompartmentPlugIn : public SBasePlugIn
{
public:
 AppearCompartmentPlugIn (const std::string &uri, const std::string &prefix, SBMLNamespaces *sbmlns);
 AppearCompartmentPlugIn(const AppearCompartmentPlugIn& orig);
 virtual ~AppearCompartmentPlugIn ();
 AppearCompartmentPlugIn& operator=(const AppearCompartmentPlugIn& orig);
 virtual AppearCompartmentPlugIn* clone () const;
 virtual void addExpectedAttributes(ExpectedAttributes& attributes);
 virtual void readAttributes (const XMLAttributes& attributes,
 const ExpectedAttributes& expectedAttributes);
 virtual void writeAttributes (XMLOutputStream& stream) const;
 std::string getShape() const;
 int setShape(std::string value);
protected:
 std::string mShape;
};
```

adding 'shape'  
attribute

# Implementing a package

## 2a. CompartmentPlugIn class

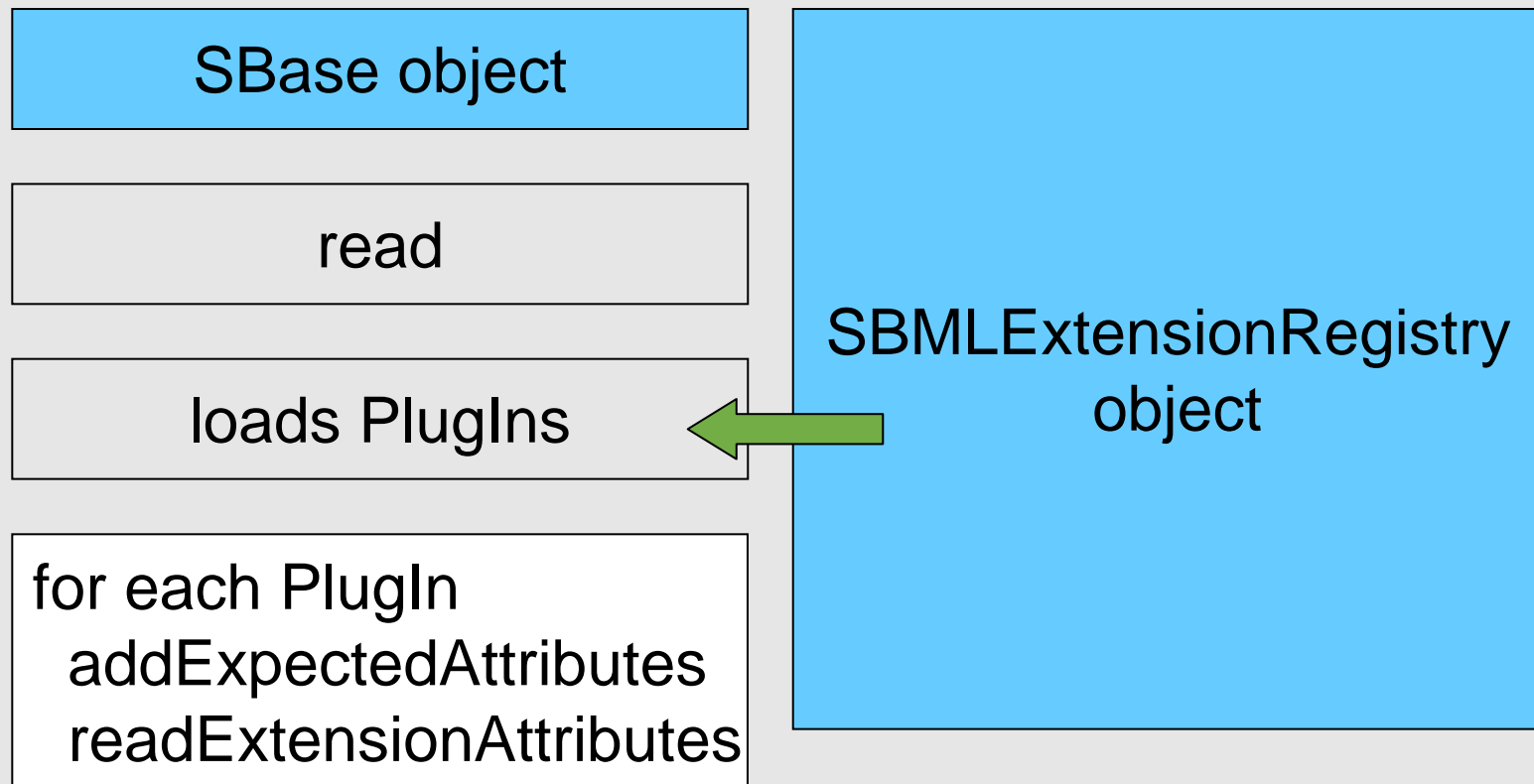
```
class AppearCompartmentPlugIn : public SBasePlugIn
{
public:
 AppearCompartmentPlugIn (const std::string &uri, const std::string &prefix, SBMLNamespaces *sbmlns);
 AppearCompartmentPlugIn(const AppearCompartmentPlugIn& orig);
 virtual ~AppearCompartmentPlugIn ();
 AppearCompartmentPlugIn& operator=(const AppearCompartmentPlugIn& orig);
 virtual AppearCompartmentPlugIn* clone () const;

virtual void addExpectedAttributes(ExpectedAttributes& attributes);
virtual void readAttributes (const XMLAttributes& attributes,
std::string getShape() const; const ExpectedAttributes& expectedAttributes);
virtual void writeAttributes (XMLOutputStream& stream) const;
 int setShape(std::string value);

protected:
 std::string mShape;
};
```

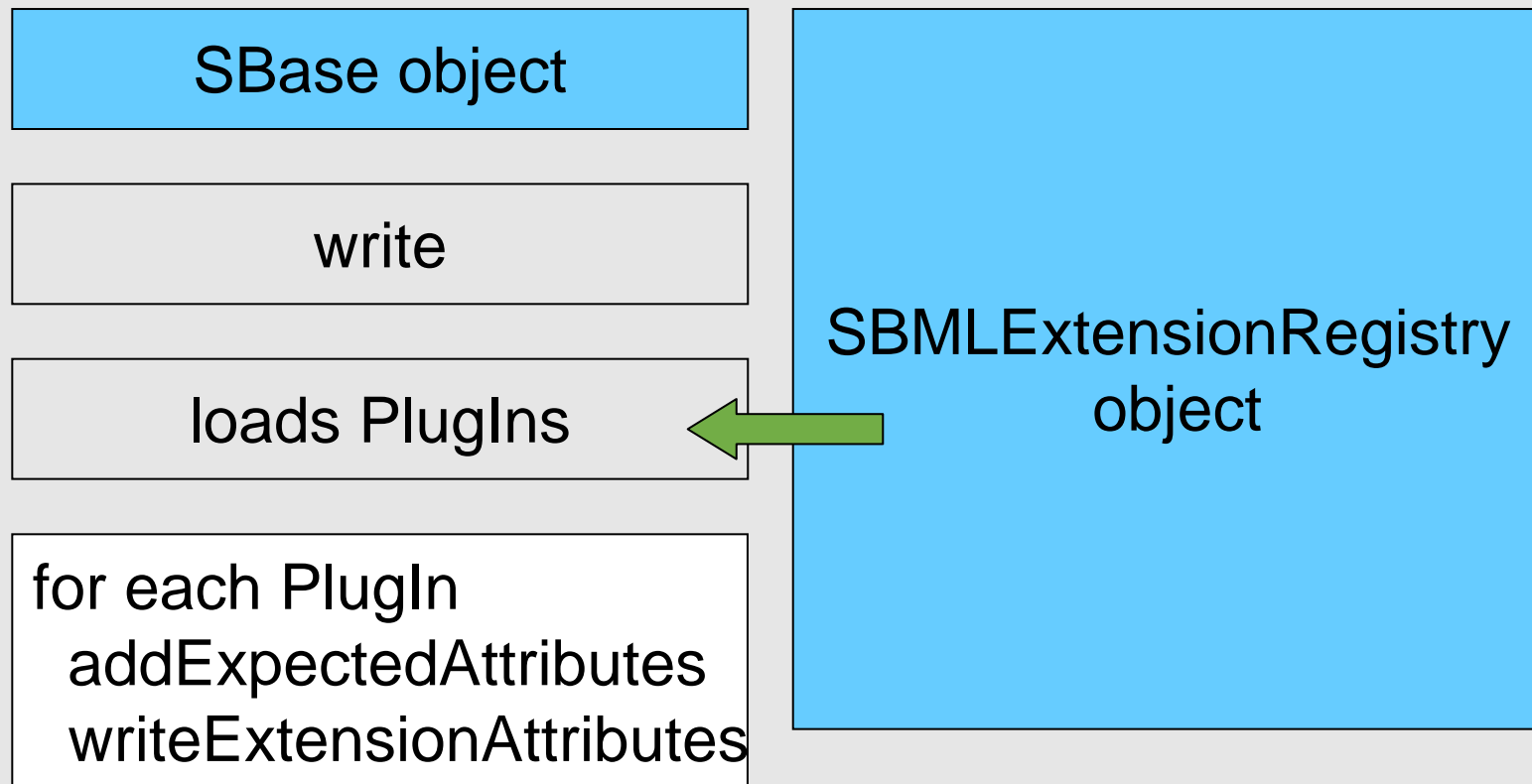
# Implementing a package

## 2a. CompartmentPlugIn class



# Implementing a package

## 2a. CompartmentPlugIn class



# Implementing a package

## 2a. CompartmentPlugIn class

```
class AppearCompartmentPlugIn : public SBasePlugIn
{
public:
 AppearCompartmentPlugIn (const std::string &uri, const std::string &prefix, SBMLNamespaces *sbmlns);
 AppearCompartmentPlugIn(const AppearCompartmentPlugIn& orig);
 virtual ~AppearCompartmentPlugIn ();
 AppearCompartmentPlugIn& operator=(const AppearCompartmentPlugIn& orig);
 virtual AppearCompartmentPlugIn* clone () const;

 virtual void addExpectedAttributes(ExpectedAttributes& attributes);
 virtual void readAttributes (const XMLAttributes& attributes,
 const ExpectedAttributes& expectedAttributes);
 std::string getShape() const;
 int setShape(std::string value);
 virtual void writeAttributes (XMLOutputStream& stream) const;

protected:
 std::string mShape;
};
```

read/write 'shape' attribute

# Implementing a package

## 2a. CompartmentPlugIn class

```
class AppearCompartmentPlugIn : public SBasePlugIn
{
public:
 AppearCompartmentPlugIn (const std::string &uri, const std::string &prefix, SBMLNamespaces *sbmlns);
 AppearCompartmentPlugIn(const AppearCompartmentPlugIn& orig);
 virtual ~AppearCompartmentPlugIn ();
 AppearCompartmentPlugIn& operator=(const AppearCompartmentPlugIn& orig);
 virtual AppearCompartmentPlugIn* clone () const;
 virtual void addExpectedAttributes(ExpectedAttributes& attributes);
 virtual void readAttributes (const XMLAttributes& attributes,
 const ExpectedAttributes& expectedAttributes);
 virtual void writeAttributes (XMLOutputStream& stream) const;

std::string getShape() const;
int setShape(std::string value);
protected:
 std::string mShape;
};
```

manipulate 'shape' attribute

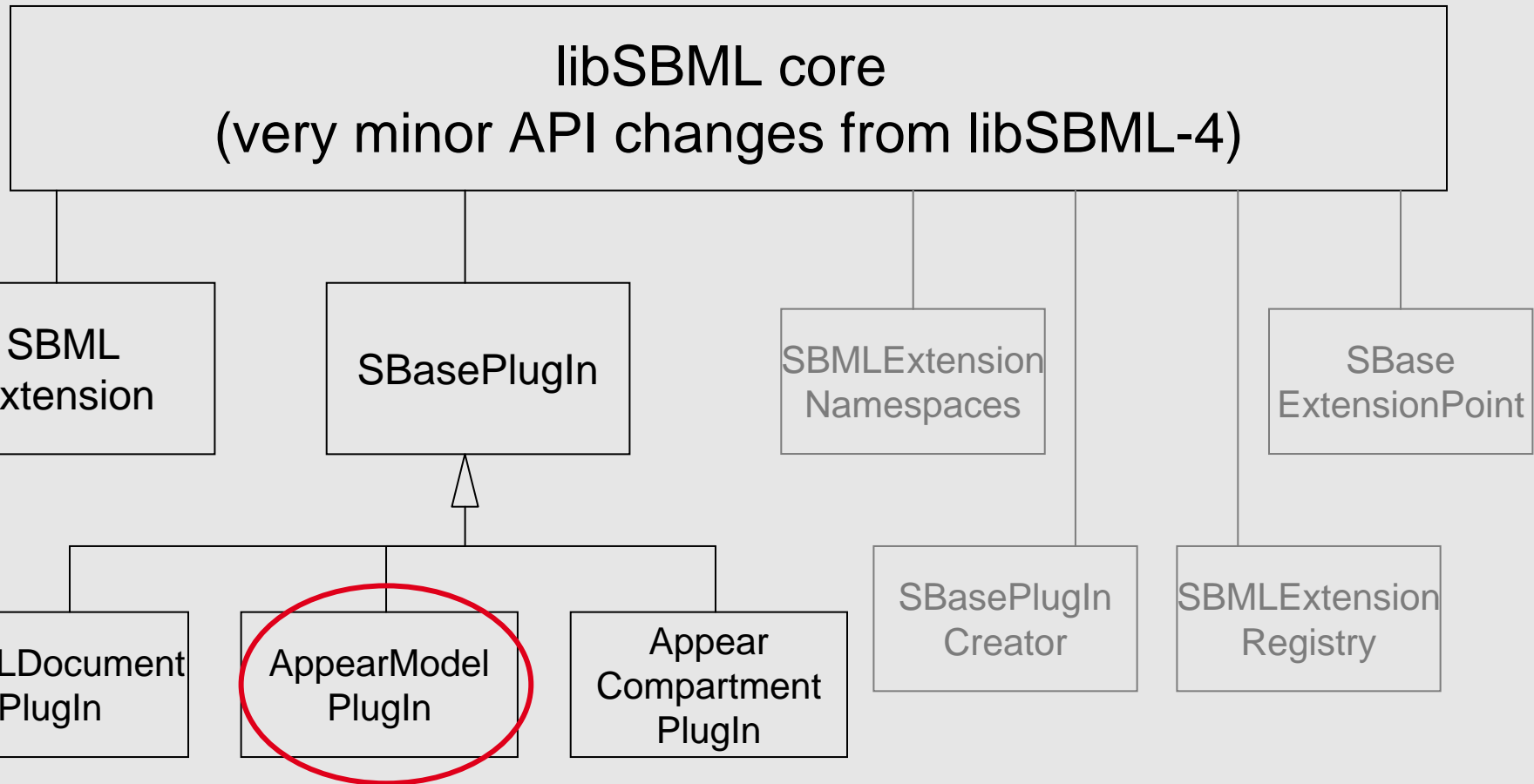
# Implementing a package

## 2a. CompartmentPlugin class

```
AppearCompartmentPlugin * plugin =
static_cast<AppearCompartmentPlugin*>(comp->getPlugin("appear");

plugin->setShape("circle");
```

# Implementing a package





# Implementing a package

## 2b. ModelPlugin class

```
class AppearModelPlugin : public SBasePlugin
{
public:
 Shape* createObject (XMLInputStream& stream);
 virtual void writeElements (XMLOutputStream& stream) const;

 const ListOfShapes* getListOfShapes () const;

 Shape* getShape (unsigned int index);

 int addShape (const Shape* Shape);
 Shape* createShape();
 Shape* removeShape (unsigned int n);

 int getNumShapes() const;

protected:

 ListOfShapes mShapes;
};
```

# Implementing a package

## 2b. ModelPlugin class

```
class LIBSBML_EXTERN AppearModelPlugin : public SBasePlugin
{
public:

 virtual SBase* createObject (XMLInputStream& stream);
 virtual void writeElements (XMLOutputStream& stream) const;

 const ListOfShapes* getListOfShapes () const;

 Shape* getShape (unsigned int index);

 int addShape (const Shape* Shape);
 Shape* createShape();
 Shape* removeShape (unsigned int n);
protected:
 int getNumShapes() const;

 ListOfShapes mShapes;
};
```

adding  
'listOfShapes'  
element

# Implementing a package

## 2b. ModelPlugin class

```
class LIBSBML_EXTERN AppearModelPlugin : public SBasePlugin
{
public:

 virtual SBase* createObject (XMLInputStream& stream);
 virtual void writeElements (XMLOutputStream& stream) const;

 Shape* getShape (unsigned int index);

 int addShape (const Shape* Shape);
 Shape* createShape();
 Shape* removeShape (unsigned int n);

 int getNumShapes() const;

protected:

 ListOfShapes mShapes;
};
```

create/write  
subelement Shape

# Implementing a package

## 2b. ModelPlugin class

```
class LIBSBML_EXTERN AppearModelPlugin : public SBasePlugin
{
public:
 const ListOfShapes* getListOfShapes () const;
 virtual void writeElements (XMLOutputStream& stream) const;

 Shape* getShape (unsigned int index);

 int addShape (const Shape* Shape);
 Shape* createShape();
 Shape* removeShape (unsigned int n);

protected:
 int getNumShapes() const;
 ListOfShapes mShapes;
};
```

manipulate  
'listOfShapes' element

# Implementing a package

## 2a. ModelPlugin class

```
AppearModelPlugin * m_plugin =
 static_cast<AppearModelPlugin*>
 (model->getPlugin("appear");

Shape *s = m_plugin->createShape();
s->setId("circle");
```

# Implementing a package

## 3. Using the package

```
int main(int argc, char** argv)
{
 SBMLNamespaces sbmlns(3, 1);
 sbmlns.addPkgNamespace("appear", 1);

 SBMLDocument *document = new SBMLDocument(&sbmlns);
 document->setPkgRequired("appear", false);

 Model * m = document->createModel();
 Compartment * c = m->createCompartment();
 c->setId("c");
 c->setConstant(true);

 AppearModelPlugin * m_plugin = static_cast<AppearModelPlugin*>.(m->getPlugin("appear"));

 Shape *s = m_plugin->createShape();
 s->setId("circle");

 AppearCompartmentPlugin * plugin = static_cast<AppearCompartmentPlugin*>.(c->getPlugin("appear"));

 plugin->setShape("circle");
 writeSBML(document, 'appear.xml');

 delete document;
}
```

# Implementing a package

## 3. Using the package

```
int main(int argc, char** argv)
{
 SBMLNamespaces sbmlns(3, 1);
 sbmlns.addPkgNamespace("appear", 1);
 document doc("test", false);
 Model * m = document->createModel();
 Compartment * c = m->createCompartment();
 c->setId("c");
 c->setConstant(true);
 AppearModelPlugin * m_plugin = static_cast<AppearModelPlugin*>.(m->getPlugin("appear"));

 Shape *s = m_plugin->createShape();
 s->setId("circle");
 AppearCompartmentPlugin * plugin = static_cast<AppearCompartmentPlugin*>.(c->getPlugin("appear"));

 plugin->setShape("circle");
 writeSBML(document, 'appear.xml');

 delete document;
}
```

# Implementing a package

## 3. Using the package

```
int main(int argc, char** argv)
{
 SBMLNamespaces sbmlns(3,1);
 sbmlns.addPkgNamespace("appear", 1,);

 SBMLDocument *document = new SBMLDocument(&sbmlns);
 document->setPkgRequired("appear", false);
 Model * m = m->createModel();
 Compartment * c = m->createCompartment();
 c->setId("c");
 c->setConstant(true);

 AppearModelPlugin * m_plugin = static_cast<AppearModelPlugin*>.(m->getPlugin("appear"));

 Shape *s = m_plugin->createShape();
 s->setId("circle");

 AppearCompartmentPlugin * plugin = static_cast<AppearCompartmentPlugin*>.(c->getPlugin("appear"));

 plugin->setShape("circle");
 writeSBML(document, 'appear.xml');

 delete document;
}
```



# Implementing a package

## 3. Using the package

```
int main(int argc, char** argv)
{
 SBMLNamespaces sbmlns(3,1);
 sbmlns.addPkgNamespace("appear", 1);

 SBMLDocument *document = new SBMLDocument(&sbmlns);
 document->setPkgRequired("appear", false);

 Model * m = document->createModel();
 Compartment * c = m->createCompartment();
 c->setId("c");
 c->setConstant(true);
 AppearCompartmentPlugin * plugin = static_cast<AppearCompartmentPlugin*>.(m->getPlugin("appear"));
 Shape * s = m->plugin->createShape();
 s->setId("circle");

 AppearCompartmentPlugin * plugin = static_cast<AppearCompartmentPlugin*>.(c->getPlugin("appear"));

 plugin->setShape("circle");
 writeSBML(document, 'appear.xml');

 delete document;
}
```

# Implementing a package

## 3. Using the package

```
int main(int argc, char** argv)
{
 SBMLNamespaces sbmlns(3,1);
 sbmlns.addPkgNamespace("appear", 1);

 SBMLDocument *document = new SBMLDocument(&sbmlns);
 document->setPkgRequired("appear", false);

 Model * m = document->createModel();
 Compartment * c = m->createCompartment();
 AppearModelPlugin * m_plugin = static_cast<AppearModelPlugin*>
 (m->getPlugin("appear"));
 c->setConstant(true);

 Shape *s = m_plugin->createShape();
 s->setId("circle");
 AppearCompartmentPlugin * c_plugin = static_cast<AppearCompartmentPlugin*>
 (c->getPlugin("appear"));
 c_plugin->setShape("circle");
 writeSBML(document, 'appear.xml');

 delete document;
}
```

# Implementing a package

## 3. Using the package

```
int main(int argc, char** argv)
{
 SBMLNamespaces sbmlns(3,1);
 sbmlns.addPkgNamespace("appear", 1);

 SBMLDocument *document = new SBMLDocument(&sbmlns);
 document->setPkgRequired("appear", false);

 Model * m = document->createModel();
 Compartment * c = m->createCompartment();
 c->setId("c");
 c->setConstant(true);

 AppearModelPlugin * m_plugin = static_cast<AppearModelPlugin*>.(m->getPlugin("appear"));

 Shape *s = m_plugin->createShape();
 s->setId("circle");

 AppearCompartmentPlugin * plugin =
 static_cast<AppearCompartmentPlugin*>(c->getPlugin("appear"));
 writeSBML(document, 'appear.xml');

 delete document;
 plugin->setShape("circle");
}
```

# Implementing a package

## 3. Using the package

```
int main(int argc, char** argv)
{
 SBMLNamespaces sbmlns(3,1);
 sbmlns.addPkgNamespace("appear", 1);

 SBMLDocument *document = new SBMLDocument(&sbmlns);
 document->setPkgRequired("appear", false);

 Model * m = document->createModel();
 Compartment * c = m->createCompartment();
 c->setId("c");
 c->setConstant(true);

 AppearModelPlugin * m_plugin = static_cast<AppearModelPlugin*>.(m->getPlugin("appear"));

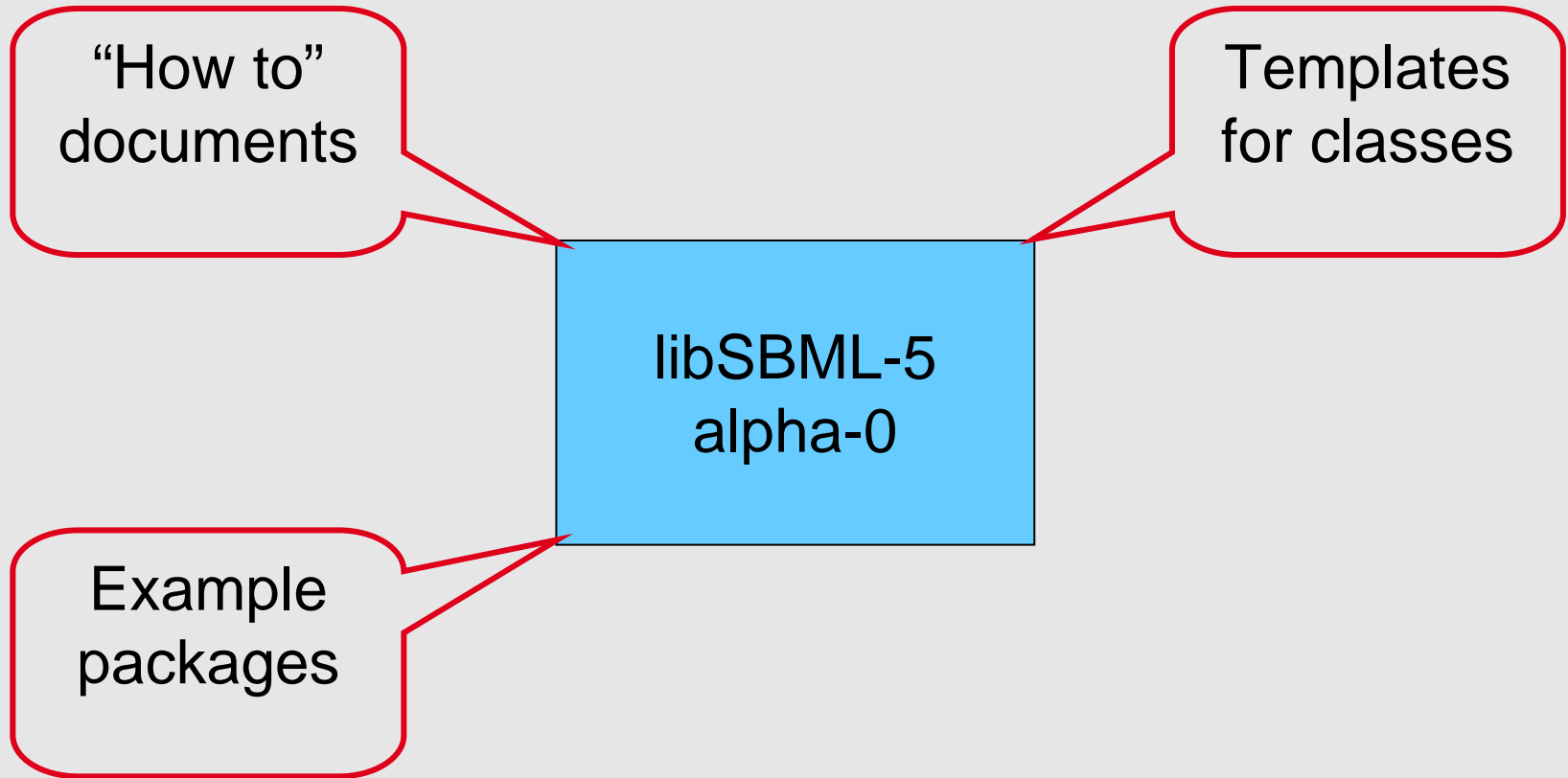
 Shape *s = m_plugin->createShape();
 s->setId("circle");
 AppearModelPlugin * c_plugin = static_cast<AppearModelPlugin*>.(c->getPlugin("appear"));
 plugin->setShape("circle");
 delete document;
}
```

# Implementing a package

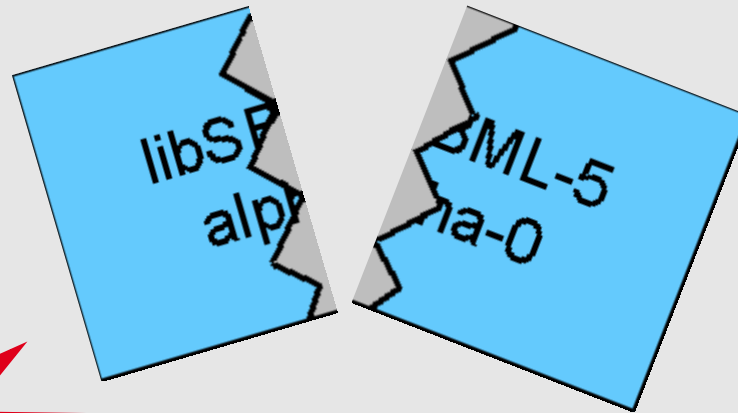
## 3. Using the package

```
<?xml version="1.0" encoding="UTF-8"?>
<sbml xmlns="http://www.sbml.org/sbml/level3/version1/core" level="3" version="1"
xmlns:appear="http://www.sbml.org/sbml/level3/version1/appear/version1"
 appear:required="false">
 <model>
 <listOfCompartments>
 <compartment id="c" constant="true" appear:shape="circle"/>
 </listOfCompartments>
 <appear:listOfShapes>
 <appear:shape appear:id="circle"/>
 </appear:listOfShapes>
 </model>
</sbml>
```

# libSBML-5



# libSBML-5



Please

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Keio, Japan



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Caltech, USA