Translation Rules

High-Level

- $[\![ParmList]\!]_{params}$: translates a list of method parameters
- $[\![ParmList]\!]_{vars}$: translates a list of variables
- $[\![MethBody]\!]_{block}$: translates a Java block, for example a method body
- $[\![Method]\!]_{appMeth}$: translates active application methods into *Circus* actions
- $[\![Method]\!]_{dataMeth}$: translates data methods into an ***Oh*Circus** method

Low-Level

- $[\![Name]\!]_{name}$: translates the *name* to a Z identifier
- $[\![varType]\!]_{type}$: translates types
- $[\![expr]\!]_{expression}$: translates expressions

Auxiliary Functions

- $IdOf(name)$: yields the identifier of a component called *name*
- $MethName(method)$: yields the method name of *method*

Safelet

```
1  public class Identifier implements Safelet
2  {
3     FieldDeclaration_1
4     ...
5     FieldDeclaration_n
6
7     ConstructorDeclaration
8
9     initializeApplication
10
11    getSequencer
12
13    AppMeth_1
14    ...
15    AppMeth_n
16 }
```

process $[\![Identifier]\!]_{Name}$ $App \mathrel{\widehat=} [\![[\![ConstructorDeclaration]\!]_{Method}]\!]_{Parameters}$ **begin**

State

$this : \text{ref } [\![Identifier]\!]_{name}\ Class$

state *State*

Init

$State'$

$this := \textbf{new } [\![Identifier]\!]_{name}\ Class()$

$$InitializeApplication \mathrel{\widehat{=}} \left(\begin{array}{l} initializeApplicationCall \longrightarrow \\ [\![\, [\![\, InitializeApplication \,]\!]_{Method} \,]\!]_{MethBody} \\ initializeApplicationRet \longrightarrow \\ \mathbf{Skip} \end{array}\right)$$

$$GetSequencer \mathrel{\widehat{=}} \left(\begin{array}{l} getSequencerCall \longrightarrow \\ getSequencerRet\,!\,[\![\, GetSequencer \,]\!]_{Returns} \longrightarrow \\ \mathbf{Skip} \end{array}\right)$$

$[\![AppMeth\_1]\!]_{Method}$

$\ldots$

$[\![AppMeth\_n]\!]_{Method}$

$$Methods \mathrel{\widehat{=}} \left(\begin{array}{l} GetSequencer \\ \Box \\ InitializeApplication \\ \Box \\ MethName(AppMeth\_1) \\ \Box \\ \ldots \\ MethName(AppMeth\_n) \\ \ldots \end{array}\right) ;\ Methods$$

$\bullet\ (Init\ ;\ Methods)\ \ \triangle(end\_safelet\_app \longrightarrow \mathbf{Skip})$

end

Mission Sequencer

```
1  public class Identifier extends MissionSequencer
2  {
3     FieldDeclaration_1
4     ...
5     FieldDeclaration_n
6
7     ConstructorDeclaration
8
9     getNextMission
10
11    AppMeth_1
12    ...
13    AppMeth_n
14 }
```

$$\textbf{process}\ [\![Identifier]\!]_{Name}\ App \mathrel{\widehat=} [\![\ [\![ConstructorDeclaration]\!]_{Method}\ ]\!]_{Parameters}\ \textbf{begin}$$

State

$$this : \text{ref}\ [\![Identifier]\!]_{name}\ Class$$

$$\textbf{state}\ State$$

Init

$$State'$$
$$this := \textbf{new}\ [\![Identifier]\!]_{name}\ Class()$$

$$GetNextMission \mathrel{\widehat=} \textbf{var}\ ret : MissionID \bullet \left(\begin{array}{l} getNextMissionCall\,.\,IdOf(Identifier) \longrightarrow \\ ret := this\,.\,getNextMission(); \\ getNextMissionRet\,.\,IdOf(Identifier)\,!\,ret \longrightarrow \\ \textbf{Skip} \end{array}\right)$$

$$[\![AppMeth\_1]\!]_{Method}$$

$$\ldots$$

$$[\![AppMeth\_n]\!]_{Method}$$

$$Methods \mathrel{\widehat=} \left(\begin{array}{l} GetNextMission \\ \Box \\ MethName(AppMeth\_1) \\ \Box \\ MethName(AppMeth\_n) \\ \ldots \end{array}\right) ;\ Methods$$

$$\bullet\ (Init\ ;\ Methods)\ \ \triangle(end\_sequencer\_app\,.\,IdOf(Identifier) \longrightarrow \textbf{Skip})$$

$$\textbf{end}$$

Mission

```
1  public class Identifier extends Mission
2  {
3     FieldDeclaration_1
4     ...
5     FieldDeclaration_n
6
7     ConstructorDeclaration
8
9     initialize
10
11    cleanUp
12
13    AppMeth_1
14    ...
15    AppMeth_n
16 }
```

process $[\![Indentifier]\!]\ App \mathrel{\widehat=} [\![\ [\![\ ConstructorDeclaration\ ]\!]_{Method}\ ]\!]_{Parameters}$ **begin**

State

$this : \text{ref}\ [\![Identifier]\!]_{name}\ Class$

state *State*

Init

$State'$

$this := \mathbf{new}\ [\![Identifier]\!]_{name}\ Class()$

$$InitializePhase \mathrel{\widehat=} \begin{pmatrix} initializeCall\,.\,IdOf(Indentifier) \longrightarrow \\ [\![initialize]\!]_{Registers}\ initializeRet\,.\,IdOf(Indentifier) \longrightarrow \\ \mathbf{Skip} \end{pmatrix}$$

$$CleanupPhase \mathrel{\widehat=} \begin{pmatrix} cleanupMissionCall\,.\,IdOf(Indentifier) \longrightarrow \\ cleanupMissionRet\,.\,IdOf(Indentifier)\,!\,\mathbf{True} \longrightarrow \\ \mathbf{Skip} \end{pmatrix}$$

$[\![AppMeth\_1]\!]_{Method}$

...

$[\![AppMeth\_n]\!]_{Method}$

$$Methods \mathrel{\widehat=} \begin{pmatrix} InitializePhase \\ \Box \\ CleanupPhase \\ \Box \\ MethName(AppMeth\_1) \\ \Box \\ MethName(AppMeth\_n) \\ \ldots \end{pmatrix} ;\ Methods$$

• $(Init\ ;\ Methods)\ \ \triangle(end\_mission\_app\ .\ IdOf(Identifier) \longrightarrow \textbf{Skip}$

end

Handlers

```
1  class Identifier extends HandlerType
2  {
3     FieldDeclaration_1
4     ...
5     FieldDeclaration_n
6
7     ConstructorDeclaration
8
9     handleAsyncEvent
10
11    AppMeth_1
12    ...
13    AppMeth_n
14 }
```

process $[\![PName]\!]\ App \mathrel{\widehat=} [\![\ [\![\ ConstructorDeclaration\ ]\!]_{Method}\ ]\!]_{Parameters}$ **begin**

State

$this : \text{ref}\ [\![Identifier]\!]_{name}\ Class$

state *State*

Init

$State'$

$this := \textbf{new}\ [\![Identifier]\!]_{name}\ Class()$

$$handleAsyncEvent \mathrel{\widehat=} \begin{pmatrix} handleAsyncEventCall\,.\,IdOf(PName) \longrightarrow \\ [\![\ [\![\ HandleAsyncBody\ ]\!]_{Method}\ ]\!]_{MethBody}; \\ handleAsyncEventRet\,.\,IdOf(PName) \longrightarrow \\ \textbf{Skip} \end{pmatrix}$$

$[\![AppMeth\_1]\!]_{Method}$

...

$[\![AppMeth\_n]\!]_{Method}$

$$Methods \mathrel{\widehat=} \begin{pmatrix} handleAsyncEvent \\ \Box \\ MethName(AppMeth\_1) \\ \Box \\ MethName(AppMeth\_n) \\ \ldots \end{pmatrix} ;\ Methods$$

$\bullet\ (Init\ ;\ Methods)\ \ \triangle(end\_[\![\ HandlerTypeIdOf(PName)\ ]\!] \longrightarrow \textbf{Skip})$

end

Managed Thread

```
1  public class Identifier extends ManagedThread
2  {
3     FieldDeclaration_1
4     ...
5     FieldDeclaration_n
6
7     ConstructorDeclaration
8
9     run
10
11    AppMeth_1
12    ...
13    AppMeth_n
14 }
```

$$\textbf{process}\ [\![PName]\!]\ App \mathrel{\widehat{=}} [\![\ [\![\ ConstructorDeclaration\ ]\!]_{Method}\ ]\!]_{Parameters}\ \textbf{begin}$$

State

$$this : \text{ref}\ [\![Identifier]\!]_{name}\ Class$$

$$\textbf{state}\ State$$

Init

$$State'$$
$$this := \textbf{new}\ [\![Identifier]\!]_{name}\ Class()$$

$$Run \mathrel{\widehat{=}} \begin{pmatrix} runCall\,.\,IdOf(PName) \longrightarrow \\ [\![\ [\![\ run\ ]\!]_{Method}\ ]\!]_{MethBody}; \\ runRet\,.\,IfOf(PName) \longrightarrow \\ \textbf{Skip} \end{pmatrix}$$

$$[\![AppMeth\_1]\!]_{Method}$$

$$\ldots$$

$$[\![AppMeth\_n]\!]_{Method}$$

$$Methods \mathrel{\widehat{=}} \begin{pmatrix} Run \\ \Box \\ MethName(AppMeth\_1) \\ \Box \\ MethName(AppMeth\_n) \\ \ldots \end{pmatrix} ;\ Methods$$

$$\bullet\ (Init\ ;\ Methods)\ \ \triangle(end\_managedThread\_app\,.\,IdOf(PName) \longrightarrow \textbf{Skip})$$

$$\textbf{end}$$

Data Class

class $[\![PName]\!]_{name}$ *Class* $\widehat{=}$ **begin**

state *State*

$[\![VarName]\!]_{name} : [\![VarType]\!]_{type}$

state *State*

initial *Init*

$State'$

$[\![VarName]\!]'_{name} = [\![VarInit]\!]_{expression}$

$[\![DataMeth1]\!]_{dataMeth}$
$[\![DataMeth2]\!]_{dataMeth}$
...

- **Skip**

end