Proposal for Wall Function, Periodic, and Rotor/Stator

BCProperty_t

The BCProperty_t data structure allows recording of special BC properties associated with particular BC patches. At the current time, only two BC properties (WallFunction_t and Area_t) are included, but other future extensions involving BCs may be implemented as additional nodes under BCProperty_t in the future.

```
BC_t  :=
  {
  BCProperty_t  BCProperty ;
  ...
  }
```

The elements of the BCProperty_t data structure:

```
BCProperty_t  :=
  {
  List (Descriptor_t  Descriptor1 ... DescriptorN) ;  (o)
  WallFunction_t  WallFunction ;                      (o)
  Area_t  Area ;                                      (o)
  List (UserDefinedData_t  UserDefinedData1 ...  ) ;  (o)
  }
```

The elements of the WallFunction_t data structure:

```
WallFunction_t  :=
  {
  List (Descriptor_t  Descriptor1 ... DescriptorN) ;  (o)
  WallFunctionType_t  WallFunctionType ;              (r)
  List (UserDefinedData_t  UserDefinedData1 ...  ) ;  (o)
  }
```

Allowable types for WallFunctionType are:

Null, UserDefined, Generic

Because there is such a wide array of methods for employing wall functions (few of which are well-documented), the type "Generic" is used to simply indicate that a wall function is employed without specifying details.

The elements of the Area_t data structure are:

```
Area_t :=
   {
   List (Descriptor_t  Descriptor1 ... DescriptorN) ;  (o)
   AreaType_t AreaType ;                               (r)
   DataArray_t<real,1,1> SurfaceArea ;                 (r)
   DataArray_t<char,1,32> RegionName ;                 (r)
   List (UserDefinedData_t  UserDefinedData1 ...  ) ;  (o)
   }

Where AreaType_t := enumeration (
   Null,
   UserDefined,
   BleedArea,
   CaptureArea ) ;
```

The RegionName is a character identifier. It is needed so that a specific region can span multiple surfaces over multiple zones.

If AreaType is set to BleedArea, the value of Area is the size of the current bleed surface. Note that bleed is commonly used with wall boundary condition. The bleed area is the surface area of the BC patch.

If AreaType is set to CaptureArea, then Area represents the size of the current capture surface. The capture area is the area of a fictitious surface in front of the inlet in which mass is pulled into the inlet. This is used to calculate the mass flow for the bc patch based on the formula:

*mass flow = MFR*rhoinf*Uinf*Acap*

where *MFR* is the desired mass flow ratio and *Acap* is the capture area. Another interpretation is the far-upstream cross-sectional area of the stream tube which feeds the inlet. Note that the capture area is usually defined with an outflow boundary condition, which is commonly used on an engine face.

GridConnectivityProperty_t

The GridConnectivityProperty_t data structure allows recording of special connectivity properties associated with particular connectivity patches. At the current time, two GridConnectivityProperty_t's are included, but other future extensions involving connectivity may be implemented as additional nodes under GridConnectivityProperty_t in the future.

```
GridConnectivity_t  :=
  {
  GridConnectivityProperty_t  GridConnectivityProperty ;
  ...
  }
```

The elements of the GridConnectivityProperty_t data structure:

```
GridConnectivityProperty_t  :=
  {
  List (Descriptor_t  Descriptor1 ... DescriptorN) ;   (o)
  Periodic_t  Periodic ;                               (o)
  AverageInterface_t  AverageInterface ;               (o)
  List (UserDefinedData_t  UserDefinedData1 ...  ) ;   (o)
  }
```

The elements of the Periodic_t data structure:

```
Periodic_t  :=
  {
  List (Descriptor_t  Descriptor1 ... DescriptorN) ;    (o)
  DataArray_t<real, 1,PhysicalDimension> RotationCenter;(r)
  DataArray_t<real, 1,PhysicalDimension> RotationAngle; (r)
  DataArray_t<real, 1 PhysicalDimension> Translation ;  (r)
  DataClass_t  DataClass ;                              (o)
  DimensionalUnits_t  DimensionalUnits ;                (o)
  List (UserDefinedData_t  UserDefinedData1 ...  ) ;    (o)
  }
```

Periodic_t is used when a connectivity interface is to be specially "tagged" as a periodic interface. RotationCenter is the reference location of an origin for defining the rotation angle between the periodic interfaces. RotationAngle defines the angle FROM the current interface TO the connecting interface. Translation defines the translation FROM the current interface TO the connecting interface.

The elements of the AverageInterface_t data structure:

```
AverageInterface_t  :=
  {
  List (Descriptor_t  Descriptor1 ... DescriptorN) ;    (o)
  AverageInterfaceType_t  AverageInterfaceType ;        (r)
  List (UserDefinedData_t  UserDefinedData1 ...  ) ;    (o)
  }
```

Allowable types for AverageInterfaceType are:

> Null, UserDefined, AverageAll, AverageCircumferential,
> AverageRadial, AverageI, AverageJ, AverageK

AverageInterface_t is used when the current connectivity interface is averaged in some special way prior to passing connectivity data to its neighboring interface. AverageAll means that the data from the entire current patch is averaged,

whereas each of the other choices indicates averaging of the data on the current interface in a particular direction (note that AverageI, AverageJ, AverageK apply only to structured type grids).

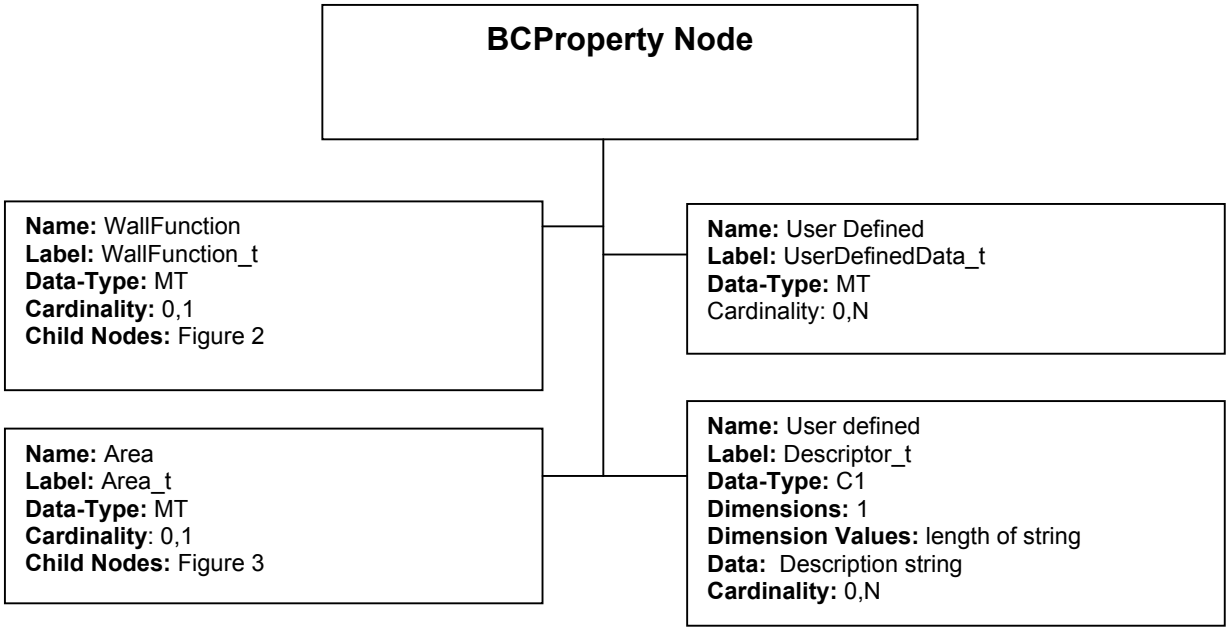

Figure 1: BCProperty_t Data Structure

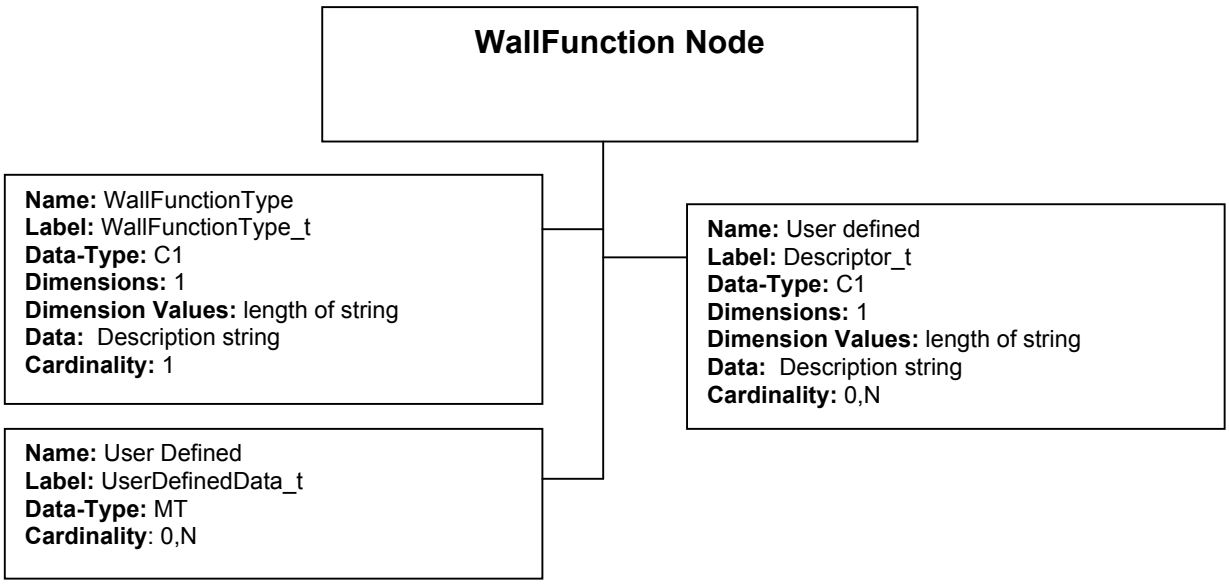

Figure 2: WallFunction_t data structure

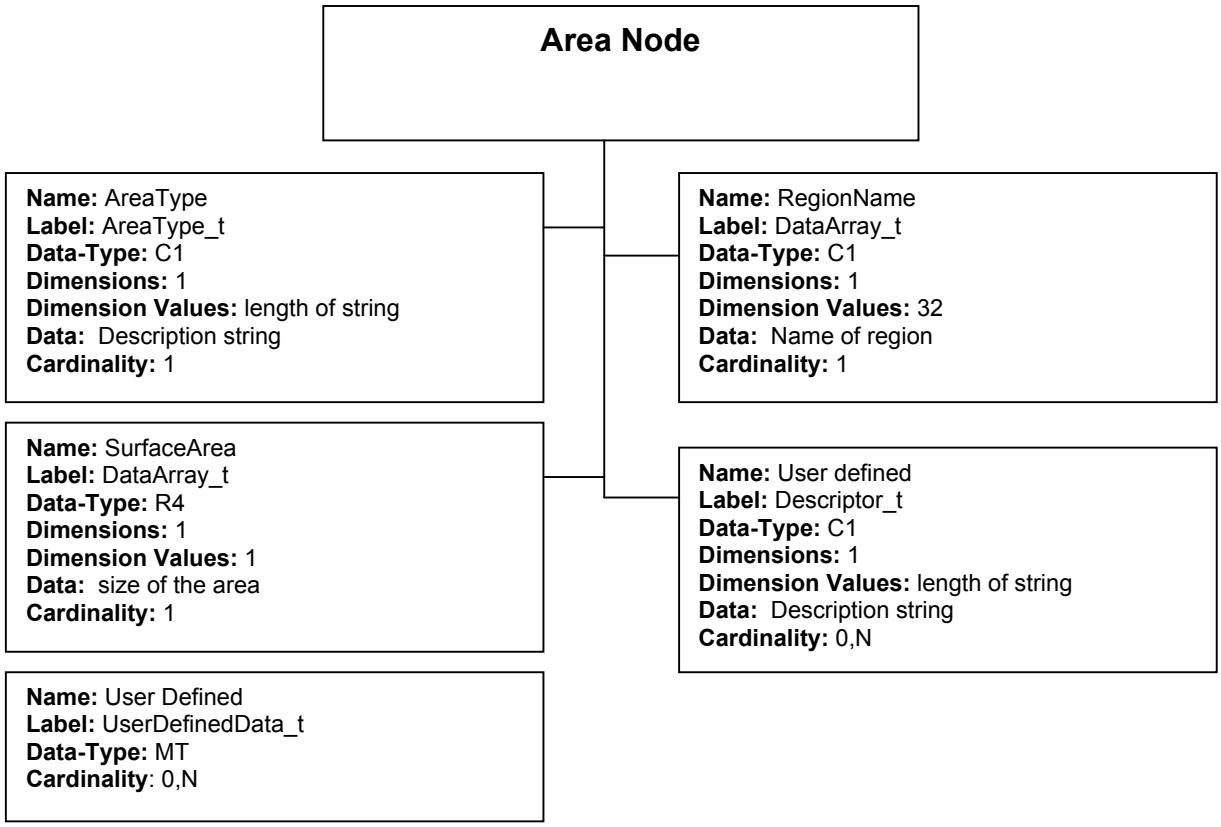

Figure 3: Area_t data structure

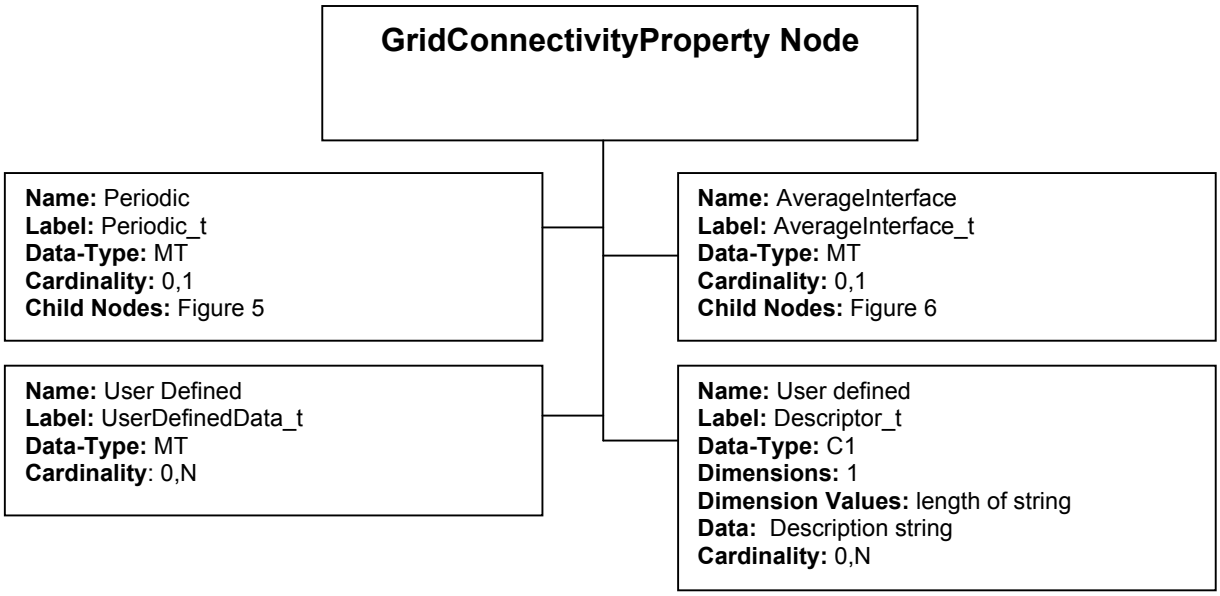

Figure 4: GridConnectivityProperty_t data structure

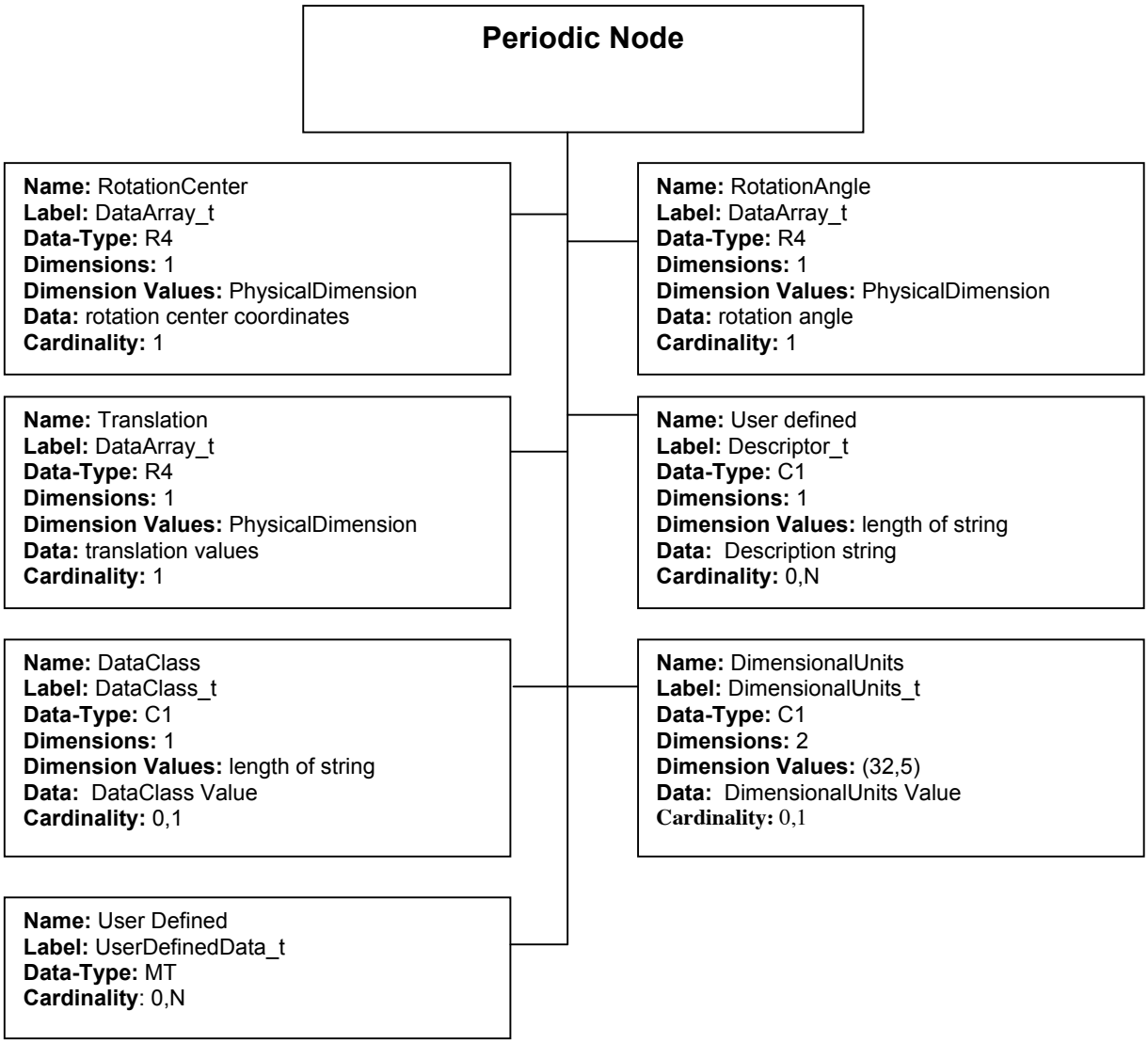

Figure 5: Periodic_t data structure

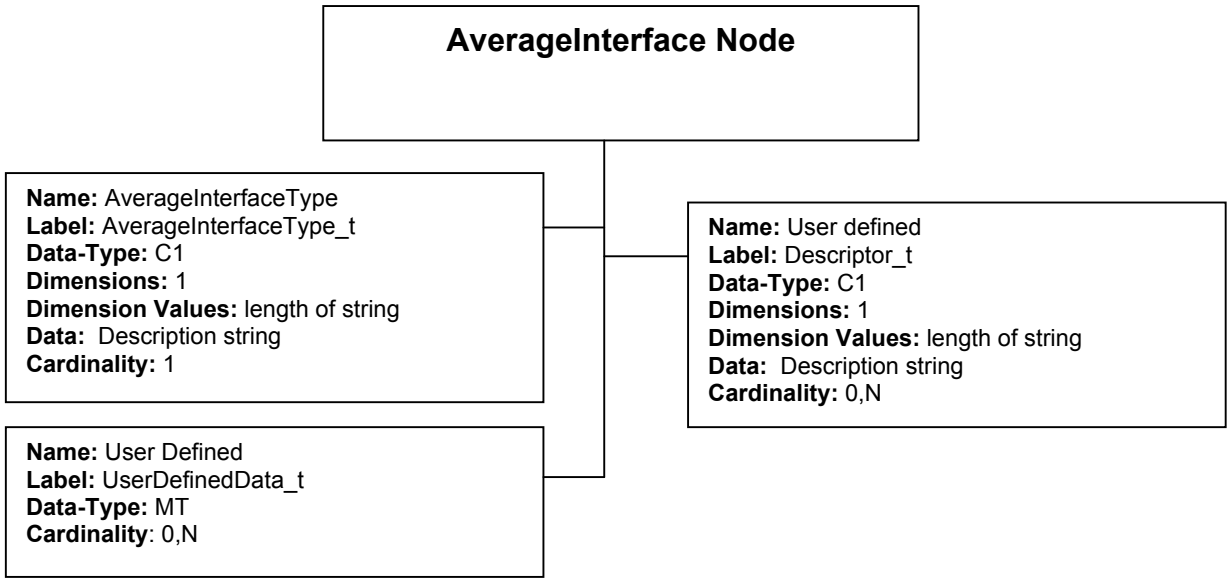

Figure 6: AverageInterface_t data structure