

DDM Improvements for IEEE Standard 1516

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Motivation for Change - Routing to One Space

- **Currently the I/F Spec restricts the user to routing object class attributes and interactions to one routing space**
- **Suggested workarounds have additional issues**
 - **Replicate attribute in SOM/FOM and route the copies to different spaces**
 - **Requires rewriting sending federate to duplicate updates**
 - **Additional overhead for multiple updates sent through RTI**
 - **“Merge” dimensions of desired routing spaces into a single routing space**
 - **Requires rewriting federates to add dimensions to region creation**
 - **Removes conceptual separateness of routing spaces**
 - **May result in additional DDM overhead in the RTI**



Motivation for Change - Subclassed Interactions

- **Interactions assigned to routing spaces at the class level**
- **Interactions may be subclassed**
 - **New parameters added**
 - **But subclassed interactions can be routed to different routing spaces than their superclasses**
- **Without DDM, subscribing federates should receive subclassed interactions promoted to the level at which the federate subscribed**
- **With DDM currently, subscribing federates will never see subclassed interactions routed to a different routing space unless they explicitly subscribe for the subclass to the other routing space, defeating the intention of promotion**



Overview of Improvements

- **Routing space concept is removed**
 - **Regions as sets of dimensions remain**
- **Class attributes and interaction classes associated with subsets of global set of all dimensions in the FOM**
- **Region overlap is calculated using all (and only) the dimensions that regions have in common**
- **SOM/FOM includes default ranges for dimensions so the user doesn't have to specify all ranges of a region's extents**
 - **A special default value of "excluded" indicates that the dimension is not used in overlap calculations unless a range is explicitly given**



Changes to OMT

- **Routing space table replaced by Dimension table**
 - Routing space name column deleted
 - Value when unspecified column added
 - Default value given in percentage of RTI range for dimensions [HLADDMmin, HLADDMmax), or excluded
- **Routing space column replaced by Available dimensions column in Attribute and Parameter tables**
 - Entry of N/A still valid to indicate that DDM is not used



Routing Space Table vs. Dimension Table

Routing Space Table				
Routing Space	Dimension	Datatype	Range/set	Normalization Function
BarOrder	SodaFlavor	FlavorType	Cola, Orange, Root Beer	Linear enumerated (Flavor)
	BarQuantity	DrinkCount	[1-25]	Linear (NumberCups)
ServerOrder	WaiterId	EmpId	[1-20]	Linear (WaiterId)

Dimension Table			
Name	Datatype	Normalization Function	Value When Unspecified
SodaFlavor	FlavorType	Linear enumerated (Flavor([Cola, Orange, RootBeer]))	[0.0 .. 1.0]
BarQuantity	DrinkCount	Linear (NumberCups, 1, 25)	[0.0 .. 0.04]
WaiterId	EmpId	Linear (WaiterId, 1, 20)	Excluded

We assume that by default we're interested in all soda flavors.

The default BarQuantity is 1, which is normalized to HLADDMmin, but we specify a small range around the default value because the default value is discrete.

Routing space column in attribute and parameter tables replaced by Dimensions column.



Changes to I/F Spec - Routing Spaces and Default Regions

- **All mention of routing spaces goes away**
- **Default routing space and default regions replaced by a single default region**
 - **Range is [RTI_min, RTI_max) for all dimensions**
 - **Like the default routing space and previous default regions, it cannot be referred to directly**



Changes to I/F Spec - Region Overlaps

- **Regions overlap if and only if their extent sets overlap**
- **Extent sets overlap if at least one extent in each set overlaps**
- **Extents overlap if all ranges of the *common* dimensions overlap**
 - **If two extents don't have any dimensions (including unspecified dimensions) in common, they do not overlap**



Changes to I/F Spec - APIs

- **Create Region**
 - **SpaceHandle** replaced by **DimensionHandleSet**
- **getRoutingSpaceHandle** and **getRoutingSpaceName**
 - Deleted
- **getAttributeRoutingSpaceHandle** and **getInteractionRoutingSpaceHandle**
 - Replaced by **getAvailableDimensionsForClassAttribute** and **getAvailableDimensionsForInteractionClass**
- **getDimensionHandle** and **getDimensionName**
 - **SpaceHandle** parameter and **SpaceNotDefined** exception deleted



Middleware Test Implementation

- **Perceptronics emulated the proposed change using middleware on top of RTI 1.3 v4**
 - *NO CHANGES WERE MADE TO RTI 1.3*
- **Map existing APIs to proposed APIs**
- **Maintain data structures to manage default ranges and region realizations from region specifications**
- **Added auxiliary FED file to emulate FED file changes**
- **Ran 7 test cases to prove functional correctness, especially of overlap calculations**

Additive DDM Association/Subscription Semantics

- Association and subscription of attributes were “*additive*” with respect to new regions and “*replacement*” with existing object/region sets.
- Interaction subscriptions were “*additive*” with respect to new regions and “*replacement*” with existing regions.
- Additive DDM Association / Subscription Semantics
 - Always use “*additive*” semantics with regions
 - Same benefits / impacts as for DM and avoids astonishment
 - Attributes can be updated and interactions can be sent to multiple regions
 - Consistent with elimination of routing spaces