Finite State Machine Component for RTC (FSM4RTC)

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Preface

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1 Scope

This specification defines the following items by extending the RTC specifications:

1. Service interface which provides FSM component meta data including an FSM structure together with appropriate data models.
2. Service interface which provides the current state of the FSM component.
3. Service interface which notifies internal actions of the FSM component including state transitions.
4. Extended RTC::PortService which receives structured event data from outside.
5. Data model to describe structured event data including events with parameters.

2 Conformance

2.1 Changes to RTC Specification

This specification does not modify the adopted RTC specification. It reuses and/or adds functionality on top of the current RTC specification.

2.2 Conformance points

This specification defines the following conformance points:

1. Component Observer (see 7.2.4)
2. Extended FSM Service (see 7.2.5)
3. Data Port Profiles (see 7.2.6)

Conformance with the “FSM4RTC” specification requires conformance with all the mandatory conformance points.

3 Normative References

The following normative documents contain provisions, which, through reference in this text, constitute provisions of this specification. For dated references, subsequent amendments to, or revisions of any of these publications do not apply.


4 Terms and Definitions

For the purposes of this specification, the following terms and definitions apply.

**Robotic Technology Component (RTC)**
A logical representation of a hardware and/or software entity that provides well-known functionality and services.

**Super Distributed Object (SDO)**
A logical representation of a hardware device or a software component that provides well-known functionality and services.

**Extensible Markup Language (XML)**
A markup language that defines a set of rules for encoding documents in a format that is both human-readable and machine-readable.

**XML Metadata Interchange (XMI)**
An OMG standard for exchanging metadata information via XML.

**State Chart XML (SCXML)**
An XML-based markup language which provides a generic state-machine based execution environment based on UML Statecharts.

5 Symbols

There are no special symbols or terms.

6 Additional Information

6.1 Acknowledgements

The following company submitted this specification:

- Honda R&D Co., Ltd.
  Fundamental Technology Research Center
  8-1 Honcho, Wako-shi, Saitama, 351-0188 Japan
  Contact: Makoto Sekiya (makoto_sekiya@n.f.rd.honda.co.jp)

The following company supported this specification:

- National Institute of Advanced Industrial Science and Technology
7 Finite State Machine Component for Robotic Technology Components (FSM4RTC)

7.1 General

According to the RTC specification, a Finite State Machine (FSM) component can be defined as Figure 7.1. However, access methods and interfaces to ensure interoperability of the FSM component are not defined in the specification.

Thus, tools and other RTCs are not able to get notifications, the current state, and the structure from the FSM component in an interoperable way. In addition to that, the definition of ports in the RTC specification is not sufficient to provide RTCs with the standard data communication method.

Figure 7.2 shows a use case as a solution. ComponentObserver gets notifications from the FSM components. ExtendedFsmService is an interface for setting/getting the current state and an FSM structure data model which contains states and transition rules of the FSM. Using DataPort, other RTCs can send events with data to the FSM components.

This specification uses SDOService and key/values properties of PortProfile and ConnectorProfile to extend the RTC specification so that components conform to the RTC specification can communicate both existing RTCs and extended RTCs.

The PIM for the above interface is specified in sub clause 7.2 and the PSM is specified in sub clause 7.3.

Figure 7.1 – An example declaration of FSM component (non-normative)
7.2 Platform Independent Model (PIM)

7.2.1 Overview

This sub clause specifies the PIM for service interfaces and data models. At first, in 7.2.3, basic types are introduced. Sub clause 7.2.4, “ComponentObserver” describes the PIM for the interface and data model, which are used to receive notifications from RTCs. Sub clause 7.2.5, “ExtendedFsmService” defines the interfaces and data models to access and manipulate the structure of the FSM. Sub clause 7.2.6, “Data Port” introduces DataPushService and DataPullService interfaces realize push/pull types of data communication models and properties specify the detail parameters for data communication. Figure 7.3 shows an overview UML notation of the PIM.
7.2.2 Format and Conventions

This specification uses UML diagrams [UML] to show classes and their relationships. All classes are part of the RTC package extended by FSM4RTC (Finite State Machine Component for RTC) specification. If, in a UML diagram, a class's attribute and operation compartments are suppressed, then this class is elaborated elsewhere. In this case, the diagram might also not show all of the class' associations. However, if a class is shown to have only an attribute or an operation compartment, then this signifies that the not-shown compartment is empty. I.e., if a class is shown with an attribute but no operation compartment, then the class does not have any operations.
### 7.2.3 Basic Types

This specification reuses the types from [UML], [SDO], [RTC]. These reused types are described in this sub clause.

#### 7.2.3.1 String [UML]

**Description**

The *String* primitive type represents a character string that can be used for any character set. *String* is an instance of *PrimitiveType* [UML].

#### 7.2.3.2 Octet [RTC]

**Description**

The *Octet* primitive type, a specialization of *Integer* primitive type, is an unsigned integer within range [0, 255]. *Octet* is an instance of *PrimitiveType* [UML].

#### 7.2.3.3 ReturnCode_t [RTC]

![ReturnCode_t](image)

**Description**

A number of operations in this specification will need to report potential error conditions to their clients. This task shall be accomplished by means of operation “return codes” of type *ReturnCode_t*.

Operations in the PIM that do not return a value of type *ReturnCode_t* shall report errors in the following ways, depending on their return type:

- If an operation normally returns a positive numerical value (such as *get_rate*, see Section 5.2.2.6.4 of [RTC]), it shall indicate failure by returning a negative value.

- If an operation normally returns an object reference (such as *RObject::get_component_profile*, see Section 5.4.2.2.1 of [RTC]), it shall indicate failure by returning a nil reference.
Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>OK</td>
<td>Enumeration to specify the operation completed successfully.</td>
</tr>
<tr>
<td>ERROR</td>
<td>Enumeration to specify that the operation failed with a generic, unspecified error.</td>
</tr>
<tr>
<td>BAD_PARAMETER</td>
<td>Enumeration to specify that the operation failed because an illegal argument was passed to it.</td>
</tr>
<tr>
<td>UNSUPPORTED</td>
<td>Enumeration to specify that the operation is unsupported by the implementation (e.g., it belongs to a compliance point that is not implemented).</td>
</tr>
<tr>
<td>OUT_OF_RESOURCES</td>
<td>Enumeration to specify that the target of the operation ran out of the resources needed to complete the operation.</td>
</tr>
<tr>
<td>PRECONDITION_NOT_MET</td>
<td>Enumeration to specify that a pre-condition for the operation was not met.</td>
</tr>
</tbody>
</table>

Associations

No additional associations.

7.2.3.4 NameValue [SDO]

```
NameValue
- name : String
- value : any
```

Figure 7.5 – NameValue

Description

NameValue is a pair of a name and its value defined in the sub clause 7.3.2 of [SDO].

Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>name: String</td>
<td>A name of a value.</td>
</tr>
<tr>
<td>Value: any</td>
<td>The value of the name.</td>
</tr>
</tbody>
</table>

Associations

No additional associations.
7.2.4 ComponentObserver

This sub clause specifies ComponentObserver. As Figure 7.6 shows, ComponentObserver is an SDO service which notifies status update of an RTC to other tools or RTCs. Kinds of updated status are defined as RTC::StatusKind.

Figure 7.6 – Overview of ComponentObserver PIM
7.2.4.1 StatusKind

StatusKind is an enumeration type to classify updated status in target RTC.

Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMPONENT_PROFILE</td>
<td>Enumeration to specify that the target component's RTC::ComponentProfile has been changed.</td>
</tr>
<tr>
<td>RTC_STATUS</td>
<td>Enumeration to specify that the target component's status has been changed.</td>
</tr>
<tr>
<td>EC_STATUS</td>
<td>Enumeration to specify that the target component's status of execution contexts has been changed.</td>
</tr>
<tr>
<td>PORT_PROFILE</td>
<td>Enumeration to specify that the target component's status of ports has been changed.</td>
</tr>
<tr>
<td>CONFIGURATION</td>
<td>Enumeration to specify that the target component's configuration has been changed.</td>
</tr>
<tr>
<td>RTC_HEARTBEAT</td>
<td>Enumeration to notify that the target component is alive.</td>
</tr>
<tr>
<td>EC_HEARTBEAT</td>
<td>Enumeration to notify that the target execution context is alive.</td>
</tr>
<tr>
<td>FSM_PROFILE</td>
<td>Enumeration to specify that the target component's FSM profile has been changed.</td>
</tr>
<tr>
<td>FSM_STATUS</td>
<td>Enumeration to specify that the target component's FSM status has been changed.</td>
</tr>
<tr>
<td>Enumeration</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>FSM_STRUCTURE</td>
<td>Enumeration to specify that the target component's FSM structure has been changed.</td>
</tr>
<tr>
<td>USER_DEFINED</td>
<td>Enumeration to specify a user defined notification.</td>
</tr>
<tr>
<td>STATUS_KIND_NUM</td>
<td>Enumeration to specify the number of attributes.</td>
</tr>
</tbody>
</table>

**Associations**

No additional associations.

### 7.2.4.2 ComponentObserver Interface

![ComponentObserver Interface](image)

**Figure 7.8 – ComponentObserver**

**Description**

**ComponentObserver** is an interface to notify various status changes in RTC to others. **ComponentObserver** is attached to a target RTC/SDO as an SDO service, and if an RTC/SDO's status changes, a kind of changed status and its hints are notified to observers. A non-normative assumed usage is shown as Figure 7.9.

**Operations**

<table>
<thead>
<tr>
<th>Operation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>update_status(in StatusKind status_kind, in String hint): void</td>
<td>This operation notifies a status update. The status_kind indicates the kind of updated status, and the hint give some hint about updated status.</td>
</tr>
</tbody>
</table>

**Hints**

The following hints are defined in this specification to realize interoperability of information from **ComponentObserver**. Implementation may support a part of the hints as necessary.

<table>
<thead>
<tr>
<th>HINT</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMPONENT_PROFILE</td>
<td>The comma separated name of changed profile’s key (ex. “instance_name, type_name”).</td>
</tr>
</tbody>
</table>
| RTC_STATUS | INACTIVE:Execution Context ID (ex. “INACTIVE:1002”)  
ACTIVE:Execution Context ID (ex. “ACTIVE:1002”)  
ERROR:Execution Context ID (ex. “ERROR:1002”) |
| EC_STATUS | ATTACHED:Execution Context ID (ex. “ATTACHED:1002”)  
| DETACHED:Execution Context ID (ex. “DETACHED:1002”)  
| RATE_CHANGED:Execution Context ID (ex. “RATE_CHANGED:1002”)  
| STARTUP:Execution Context ID (ex. “STARTUP:1002”)  
| SHUTDOWN:Execution Context ID (ex. “SHUTDOWN:1002”)  
| PORT_PROFILE | ADD:port name (ex. “ADD:velocity”)  
| REMOVE:port name (ex. “REMOVE:velocity”)  
| CONNECT:port name (ex. “CONNECT:velocity”)  
| DISCONNECT:port name (ex. “DISCONNECT:velocity”)  
| CONFIGURATION | UPDATE_CONFIGSET:configuration set's name  
| (ex. “UPDATE_CONFIGSET:default”)  
| UPDATE_PARAMETER:<config set's name>.<config param's key>  
| (ex. “UPDATE_PARAMETER:default.key”)  
| SET_CONFIG_SET:config set's name  
| (ex. “SET_CONFIG_SET:default”)  
| ADD_CONFIG_SET:config set's name  
| (ex. “ADD_CONFIG_SET:option”)  
| REMOVE_CONFIG_SET:config set's name  
| (ex. “REMOVE_CONFIG_SET:option”)  
| ACTIVATE_CONFIG_SET:config set's name  
| (ex. “ACTIVATE_CONFIG_SET:option”)  
| FSM_STATUS | Name of the current state  
| FSM_STRUCTURE | Name of the FSM  
| USER_DEFINED | User defined text  

**Attributes**

No additional attributes.

**Associations**

No additional associations.
7.2.5 ExtendedFsmService

This sub clause specifies ExtendedFsmService. As Figure 7.10 shows, ExtendedFsmService is an SDO service. With ExtendedFsmService, a RTC can provide extended interfaces to get the current status of the FSM and set/get the structure definition data model of the FSM for other tools and RTCs.
7.2.5.1 FsmEventProfile

**FsmEventProfile** is a data model to bind the name of event and its data type of the FSM component.

**Attributes**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>name: String</td>
<td>A name of the FSM</td>
</tr>
<tr>
<td>data_type: String</td>
<td>The type of the event data as <strong>CORBA::RepositoryID</strong></td>
</tr>
</tbody>
</table>

**Associations**

No additional associations.
7.2.5.2  FsmStructure

![Diagram of FsmStructure]

**Figure 7.12 – FsmStructure**

**Description**

FsmStructure is a data model to describe a structure of an FSM of the FSM component. FsmStructure is used to specify the name and description format of an FSM. Detail usage is explained in 7.2.5.3, “ExtendedFsmService interface.”

**Attributes**

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>name: String</td>
<td>A name of the FSM</td>
</tr>
<tr>
<td>structure: String</td>
<td>A string formatted description of the structure of the FSM</td>
</tr>
<tr>
<td>event_profiles: FsmEventProfile[]</td>
<td>An array of FsmEventProfile</td>
</tr>
<tr>
<td>properties: NameValue</td>
<td>Additional properties of the FsmStructure</td>
</tr>
</tbody>
</table>

**Properties**

Names of properties of FsmStructure have the dot-separated prefix “fsm_structure”.

<table>
<thead>
<tr>
<th>Property Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description format property of the structure of the FSM</td>
<td>The format of the structure attribute</td>
</tr>
<tr>
<td>name</td>
<td>fsm_structure.format</td>
</tr>
<tr>
<td>value</td>
<td>The specified format name of structure (ex. scxml, xmi).</td>
</tr>
</tbody>
</table>

**Associations**

No additional associations.
7.2.5.3 **ExtendedFsmService interface**

**Figure 7.13 – ExtendedFsmService**

**Description**

_FsmStructure_ is a data model to describe a structure of an FSM of the FSM component. _FsmStructure_ is used to specify the name and description format of an FSM. Detail usage is explained in 7.2.5.3, “ExtendedFsmService interface.”

**Figure 7.14 – Sequence for creating and using ExtendedFsmService (non-normative)**
Description

ExtendedFsmService is an interface to set and get the structure of an FSM in the FSM component from others. This is created by a target RTC as an SDO service and added to its own configuration. A non-normative usage is shown as Figure 7.14. Tools get the reference of an ExtendedFsmService via configuration of the target RTC. After getting the ExtendedFsmService, tools can get and set the FsmStructure of the target RTC.

Operations

<table>
<thead>
<tr>
<th>get_current_state(): String</th>
<th>This operation returns the current state of an FSM in the target FSM component.</th>
</tr>
</thead>
<tbody>
<tr>
<td>get_fsm_structure(out fsm_structure:FsmStructure): ReturnCode_t</td>
<td>This operation returns the structure of an FSM in the target FSM component. ExtendedFsmService returns the name, structure with format specified by fsm_structure.format and EventProfiles. RTCs may return UNSUPPORTED if this operation is not implemented.</td>
</tr>
<tr>
<td>set_fsm_structure(in fsm_structure:FsmStructure): ReturnCode_t</td>
<td>This operation sets an FsmStructure to the target component. Then the target component reconfigures its FSM structure such as transition rules according to the values of the given fsm_structure. RTCs may return UNSUPPORTED if this operation is not implemented.</td>
</tr>
</tbody>
</table>

Attributes

No additional attributes.

Associations

No additional associations.

7.2.6 Data Port

RTC specification provides the definition of PortService for RTCs as an interface to communicate each other. As Figure 7.15 shows, however, PortService doesn’t provide the method to send and receive a certain data type between RTCs. Thus, this specification adds the following data and service models for that purpose.
In the FSM4RTC PIM, two types of communication models are assumed. One is “Sender-push” model and the other is “Receiver-pull” model (Figure 7.16). Figure 7.17 shows how interfaces and data models collaborate to realize these communication models. As Figure 7.17, in the “Sender-push” model, an out port writes data to the buffer of a connector. And then the data is pushed to the buffer of DataPushService. Finally an in port reads the data from DataPushService. On the other hand, in the “Receiver-pull” model, when an in port calls “read,” the data written by an out port to the buffer of DataPullService is pulled from a connector and returned to the in port. “Receiver-pull” model is used to minimize the network communications between senders and receivers by pulling the data when it’s required.
Figure 7.16 – Communication model of data port (non-normative)
7.2.6.1 PortStatus

PortStatus is an enumeration type to classify result of operations of DataPushService and DataPullService.

Description

PortStatus is an enumeration type to classify result of operations of DataPushService and DataPullService.
Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PORT_OK</td>
<td>Enumeration to specify that the result of an action of the data port has been success.</td>
</tr>
<tr>
<td>PORT_ERROR</td>
<td>Enumeration to specify that the result of an action of the data port has been failed.</td>
</tr>
<tr>
<td>BUFFER_FULL</td>
<td>Enumeration to notify that the buffer of the data port is full.</td>
</tr>
<tr>
<td>BUFFER_EMPTY</td>
<td>Enumeration to notify that the buffer of the data port is empty.</td>
</tr>
<tr>
<td>BUFFER_TIMEOUT</td>
<td>Enumeration to notify that the write or read from buffer of the data port is timeout.</td>
</tr>
<tr>
<td>UNKNOWN_ERROR</td>
<td>Enumeration to specify that the result of an action of the data port has been failed with unknown error.</td>
</tr>
</tbody>
</table>

Associations

No additional associations.

7.2.6.2 PortProfile [RTC]

![PortProfile Diagram](image)

Figure 7.19 – PortProfile

Description

PortProfile is defined in [RTC] describe profiles of a port of an RTC. This specification extends PortProfile using the properties attribute as follows. These properties are used to declare supported types of communications of the port.

Properties

Properties of PortProfile are used to declare supported types of data ports provided by PortService. Names of properties have the dot-separated prefix “dataport”. Each property may have comma-separated multiple values. This section defines the minimum set of values of each property to realize interoperability among RTCs. Implementations may support additional values for each property. For example, dataport.interface_type property of an implementation which supports DDS interface includes “dds”.
Dataflow type property
Property to define supported data communication models.

<table>
<thead>
<tr>
<th>name</th>
<th>type</th>
<th>value</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dataport.dataflow_type</td>
<td>string</td>
<td>push</td>
<td>If this value exists, sender-push model is supported.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>pull</td>
<td>If this value exists, receiver-pull model is supported.</td>
</tr>
</tbody>
</table>

IO mode property
Property to define supported IO modes to write data.

<table>
<thead>
<tr>
<th>name</th>
<th>type</th>
<th>value</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dataport.io_mode</td>
<td>string</td>
<td>block</td>
<td>If this value exists, block mode is supported. In block mode, write method of an out port is blocked until the data has been pushed to DataPushService.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>nonblock</td>
<td>If this value exists, nonblock mode is supported. In nonblock mode, write method of an out port returns immediately.</td>
</tr>
</tbody>
</table>

Data type property
Property to define the data type used in data ports. PortService sets the same data type for all provided data ports.

<table>
<thead>
<tr>
<th>name</th>
<th>type</th>
<th>value</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dataport.data_type</td>
<td>string</td>
<td>name of a type</td>
<td>The data type used between connected ports.</td>
</tr>
</tbody>
</table>

Interface type property
Property to define the interface type(s) of a data port.

<table>
<thead>
<tr>
<th>name</th>
<th>type</th>
<th>value</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dataport.interface_type</td>
<td>string</td>
<td>name of a type</td>
<td>The name of a supported interface type.</td>
</tr>
</tbody>
</table>
Marshaling type property
Property to define the supported marshaling type(s) of data.

<table>
<thead>
<tr>
<th>name</th>
<th>type</th>
<th>value</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dataport.marshaling_type</td>
<td>string</td>
<td>name of a type</td>
<td>The name of a supported marshaling type.</td>
</tr>
</tbody>
</table>

Timestamp policy property
Property to define the supported timestamp policies.

<table>
<thead>
<tr>
<th>name</th>
<th>type</th>
<th>value</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dataport.timestamp_policy</td>
<td>string</td>
<td>on_write</td>
<td>If this value exists, a timestamp can be set when an out port writes data.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>on_send</td>
<td>If this value exists, a timestamp can be set before data is pushed to DataPushService or pulled from DataPullService.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>on_received</td>
<td>If this value exists, a timestamp can be set after data is pushed to DataPushService or pulled from DataPullService.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>on_read</td>
<td>If this value exists, a timestamp can be set when an in port reads data.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>none</td>
<td>If this value exists, RTCs do not set any timestamp.</td>
</tr>
</tbody>
</table>

Write buffer length property
Property to define the default length of the write buffer.

<table>
<thead>
<tr>
<th>name</th>
<th>type</th>
<th>value</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dataport.write-buffer-length</td>
<td>string</td>
<td>integer</td>
<td>A positive integer to define the length of the write buffer [byte].</td>
</tr>
</tbody>
</table>
Write buffer full policy property
Property to define the supported policies when the write buffer is full.

<table>
<thead>
<tr>
<th>name</th>
<th>type</th>
<th>value</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dataport.write.buffer.full_policy</td>
<td>string</td>
<td>overwrite</td>
<td>If this value exists, overwrite policy is supported. As overwrite policy, the oldest data is overwritten when the write buffer is full.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>do_nothing</td>
<td>If this value exists, do_nothing policy is supported. As do_nothing policy, data is not written when the write buffer is full.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>block</td>
<td>If this value exists, block policy is supported. As block policy, writing to the write buffer is blocked until the write buffer is available.</td>
</tr>
</tbody>
</table>

Write buffer timeout property
Property to define default timeout for block policy of the write buffer.

<table>
<thead>
<tr>
<th>name</th>
<th>type</th>
<th>value</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dataport.write.buffer.timeout</td>
<td>string</td>
<td>integer</td>
<td>An integer to define the timeout value of blocking [s]</td>
</tr>
</tbody>
</table>

Read buffer length property
Property to define the default length of the read buffer.

<table>
<thead>
<tr>
<th>name</th>
<th>type</th>
<th>value</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dataport.read.buffer.length</td>
<td>string</td>
<td>integer</td>
<td>A positive integer to define the length of the read buffer [byte].</td>
</tr>
</tbody>
</table>
Read buffer empty policy property
Property to define the supported policies when the read buffer is empty.

<table>
<thead>
<tr>
<th>name</th>
<th>type</th>
<th>value</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dataport.read.buffer.empty_policy</td>
<td>string</td>
<td>read_back</td>
<td>If this value exists, read_back policy is supported. As read_back policy, the read method of an in port returns the last data when the read buffer is empty.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>do_nothing</td>
<td>If this value exists, do_nothing policy is supported. As do_nothing policy, the read method of an in port returns nothing when the read buffer is empty.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>block</td>
<td>If this value exists, block policy is supported. As block policy, the read method of an in port blocks until the read buffer is available.</td>
</tr>
</tbody>
</table>

Read buffer timeout property
Property to define the default timeout for block policy of the read buffer.

<table>
<thead>
<tr>
<th>name</th>
<th>type</th>
<th>value</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dataport.read.buffer.timeout</td>
<td>string</td>
<td>string</td>
<td>Timeout of blocking [s]</td>
</tr>
</tbody>
</table>

Read buffer queue policy property
Property to define the supported queue policies of the read buffer.

<table>
<thead>
<tr>
<th>name</th>
<th>type</th>
<th>value</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dataport.read.buffer.queue_policy</td>
<td>string</td>
<td>all</td>
<td>If this value exists, all policy is supported. As all policy, all queued data in the read buffer is read at once.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>fifo</td>
<td>If this value exists, fifo policy is supported. As fifo policy, queued data in the read buffer is read with FIFO order.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>new</td>
<td>If this value exists, new policy is supported. As new policy, the latest data in the read buffer is read.</td>
</tr>
</tbody>
</table>
7.2.6.3 ConnectorProfile [RTC]

![ConnectorProfile](image)

**Figure 7.20 – ConnectorProfile**

**Description**

ConnectorProfile is defined in [RTC] to contain information for connecting the ports of collaborating RTCs. This specification extends ConnectorProfile using the properties attribute as follows. These properties are used to direct a port to provide the interface with specified configuration. If the configuration is acceptable for the port, then an instance of required interface is created and the PortService::connect operation shall return ReturnCode_t::OK. If the port is unable to provide the interface, the PortService::connect operation shall return ReturnCode_t::BAD_PARAMETER (Figure 7.21). The acceptable configurations are defined as properties of PortProfile (sub clause 7.2.6.2).
Properties

Properties of **ConnectorProfile** are used to request **PortService** to provide a specific type of data port between RTCs. Names of properties have the dot-separated prefix "dataport". Each property must have a single value.

Dataflow type property

Property to specify the requested data communication model.
### Dataflow Type

<table>
<thead>
<tr>
<th>name</th>
<th>type</th>
<th>value</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dataport.dataflow_type</td>
<td>string</td>
<td>push</td>
<td>Specified if sender-push model is requested.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>pull</td>
<td>Specified if receiver-pull model is requested.</td>
</tr>
</tbody>
</table>

**IO Mode Property**

Property to specify the requested IO mode to push or pull data.

<table>
<thead>
<tr>
<th>name</th>
<th>type</th>
<th>value</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dataport.io_mode</td>
<td>string</td>
<td>block</td>
<td>Specified if block mode is requested.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>nonblock</td>
<td>Specified if nonblock mode is requested.</td>
</tr>
</tbody>
</table>

**Interface Type Property**

Property to specify the requested interface type of a data port.

<table>
<thead>
<tr>
<th>name</th>
<th>type</th>
<th>value</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dataport.interface_type</td>
<td>string</td>
<td>name of a type</td>
<td>The name of a requested interface type. If the requested interface is not supported by the target ports, connect operations shall fail.</td>
</tr>
</tbody>
</table>

**Marshaling Type Property**

Property to specify the requested marshaling type of data.

<table>
<thead>
<tr>
<th>name</th>
<th>type</th>
<th>value</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dataport.marshaling_type</td>
<td>string</td>
<td>name of a type</td>
<td>The name of a requested marshaling type. If the requested marshaling type is not supported by the target ports, connect operations shall fail.</td>
</tr>
</tbody>
</table>
### Timestamp policy property
Property to specify the requested timestamp policy.

<table>
<thead>
<tr>
<th>name</th>
<th>type</th>
<th>value</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dataport.timestamp_policy</td>
<td>string</td>
<td>on_write</td>
<td>To request that a timestamp can be set when the output port writes data.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>on_send</td>
<td>To request that a timestamp can be set before data is pushed to DatapushService or pulled from DataPullService.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>on_received</td>
<td>To request that a timestamp can be set after data is pushed to DatapushService or pulled from DataPullService.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>on_read</td>
<td>To request that a timestamp can be set when an input port reads data.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>none</td>
<td>To request that RTCs do not set any timestamp.</td>
</tr>
</tbody>
</table>

### Write buffer length property
Property to specify the requested length of the write buffer.

<table>
<thead>
<tr>
<th>name</th>
<th>type</th>
<th>value</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dataport.write.buffer.length</td>
<td>string</td>
<td>integer</td>
<td>Requested length of the write buffer [byte].</td>
</tr>
</tbody>
</table>

### Write buffer full policy property
Property to specify the requested policy when the write buffer is full.

<table>
<thead>
<tr>
<th>name</th>
<th>type</th>
<th>value</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dataport.write.buffer.full_policy</td>
<td>string</td>
<td>overwrite</td>
<td>Specified if overwrite policy is requested.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>do_nothing</td>
<td>Specified if do_nothing policy is requested.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>block</td>
<td>Specified if block policy is requested.</td>
</tr>
</tbody>
</table>
Write buffer timeout property
Property to specify default timeout for block policy of the write buffer.

<table>
<thead>
<tr>
<th>name</th>
<th>type</th>
<th>value</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dataport.write.buffer.timeout</td>
<td>string</td>
<td>integer</td>
<td>Request to set timeout of blocking as specified value[s].</td>
</tr>
</tbody>
</table>

Read buffer length property
Property to specify the default length of the read buffer.

<table>
<thead>
<tr>
<th>name</th>
<th>type</th>
<th>value</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dataport.read.buffer.length</td>
<td>string</td>
<td>string</td>
<td>Requested length of the read buffer [byte].</td>
</tr>
</tbody>
</table>

Read buffer empty policy property
Property to specify the supported policies when the read buffer is empty.

<table>
<thead>
<tr>
<th>name</th>
<th>type</th>
<th>value</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dataport.read.buffer.empty_policy</td>
<td>string</td>
<td>read_back</td>
<td>Specified if read_back policy is requested.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>do_nothing</td>
<td>Specified if do_nothing policy is requested.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>block</td>
<td>Specified if block policy is requested.</td>
</tr>
</tbody>
</table>

Read buffer timeout property
Property to specify the default timeout for block policy of the read buffer.

<table>
<thead>
<tr>
<th>name</th>
<th>type</th>
<th>value</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dataport.read.buffer.timeout</td>
<td>string</td>
<td>integer</td>
<td>Request to set timeout of blocking as specified value[s].</td>
</tr>
</tbody>
</table>

Finite State Machine Component for RTC, v1.0
Read buffer queue policy property

Property to specify the supported queue policies of the read buffer.

<table>
<thead>
<tr>
<th>name</th>
<th>type</th>
<th>value</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dataport.read.buffer.queue_policy</td>
<td>string</td>
<td>all</td>
<td>Specified if all policy is requested.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>fifo</td>
<td>Specified if fifo policy is requested.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>new</td>
<td>Specified is new policy is requested.</td>
</tr>
</tbody>
</table>

FSM event name property

Property to bind an event name and a data port.

<table>
<thead>
<tr>
<th>name</th>
<th>type</th>
<th>value</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dataport.fsm_event_name</td>
<td>string</td>
<td>name of an event</td>
<td>The name of an event bound with the data port.</td>
</tr>
</tbody>
</table>

7.2.6.4 DataPushService Interface

Description

**DataPushService** is an interface to push an array of **Octet** to the target port with a specified binary format such as Common Data Representation (CDR) format. Figure 7.23 shows a non-normative example of a sequence diagram to create and use **DataPushService**.
Figure 7.23 – Sequence for creating and using DataPushService (non-normative)

Operations

| push(in Octet[] data: PortStatus) | This operation pushes an array of Octet to the target port with a specified binary format. |
Attributes
No additional attributes.

Associations
No additional associations.

7.2.6.5 DataPullService Interface

![DataPullService Interface Diagram]

Figure 7.24 – DataPullService

Description
DataPullService is an interface to pull an array of Octet from the target port with a specified binary format such as Common Data Representation (CDR) format. Figure 7.25 shows a non-normative example of a sequence diagram to create and use DataPullService.
Figure 7.25 – Sequence for creating and using DataPullService (non-normative)
Operations

<table>
<thead>
<tr>
<th>Operation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>pull(in Octet[] data: PortStatus)</td>
<td>This operation pulls an array of Octet from the target port with a specified binary format.</td>
</tr>
</tbody>
</table>

Attributes

No additional attributes.

Associations

No additional associations.

7.3 OMG IDL Platform Specific Model (PSM)

7.3.1 Overview

This sub clause introduces a CORBA specific model for the Finite State Machine Component for RTC (FSM4RTC) Platform Independent Model (PIM) defined in 7.2.

The FSM4RTC PIM defines the interfaces and necessary data structures. In the Platform Specific Model (PSM) these interfaces and the data structures used in the individual methods are mapped according to a CORBA IDL specification. The complete IDL specification is presented in Annex A.

An interface defined in the FSM4RTC PIM is mapped to a CORBA interface. An operation in a PIM interface is mapped to a CORBA operation. The other data types in the FSM4RTC PIM are mapped to the non-interface types in CORBA IDL. The CORBA IDL PSM is compliant with the IDL style guide [1].

In the CORBA IDL PSM, all interfaces as defined in the FSM4RTC PIM are directly mapped to CORBA interfaces. The IDL specification includes corresponding interface declarations. Additionally, all data structures used in the methods of these interfaces are also defined in the IDL specification.

The FSM4RTC IDL specification includes the following interface declarations:

Operations in the PIM that do not return a value of type ReturnCode_t shall report errors in the following ways, depending on their return type:

- Interface ComponentObserver
- interface ExtendedFsmService
- interface DataPushService
- interface DataPullService

Addition to the interfaces, data structures that are used as parameters in interface methods have to be defined in the PSM.
7.3.2 Basic Types
Basic types (see 7.2.3) shall map to the corresponding IDL types as follows.

7.3.2.1 String [UML]
String is mapped to \texttt{string}.

7.3.2.2 Octet [RTC]
Octet is mapped to \texttt{octet}.

7.3.2.3 ReturnCode_t [RTC]
\texttt{ReturnCode\_t} is mapped to \texttt{RTC::ReturnCode\_t} from RTC.idl [RTC]

7.3.2.4 NameValue [SDO]
\texttt{NameValue} is mapped to \texttt{SDOPackage::NameValue} from SDOPackage.idl [SDO].
\texttt{NameValue[]} is mapped to \texttt{SDOPackage::NVList} from SDOPackage.idl [SDO].

7.3.3 RTC module
The interfaces and data structures defined in the CORBA PSM belong to module RTC.

7.3.4 Data Types
This sub clause defines data structures that are used as parameters in FSM4RTC interface methods.

\begin{verbatim}
typedef SDOPackage::NVList NVList;
typedef sequence<octet> OctetSeq;
enum StatusKind {
    COMPONENT_PROFILE,
    RTC_STATUS,
    EC_STATUS,
    PORT_PROFILE,
    CONFIGURATION,
    RTC_HEARTBEAT,
    EC_HEARTBEAT,
}
\end{verbatim}
FSM_PROFILE,
FSM_STATUS,
FSM_STRUCTURE,
USER_DEFINED,
STATUS_KIND_NUM
};

struct FsmEventProfile {
    string name;
    string data_type;
};
typedef sequence<FsmEventProfile> FsmEventProfileList;

struct FsmStructure {
    string name;
    string structure;
    FsmEventProfileList event_profiles;
    NVList properties;
}

enum PortStatus {
    PORT_OK,
    PORT_ERROR,
    BUFFER_FULL,
    BUFFER_EMPTY,
    BUFFER_TIMEOUT,
    UNKNOWN_ERROR
}
7.3.5 ComponentObserver

7.3.5.1 ComponentObserver Interface

The ComponentObserver interface is mapped to a CORBA interface. The ComponentObserver interface supports an operation, update_status, which allows getting the list of organizations associated with the object implementing this interface.

```c++
interface ComponentObserver : SDOPackage::SDOService {
    oneway void update_status(in StatusKind status_kind, in string hint);
}
```

7.3.6 ExtendedFsmService

7.3.6.1 ExtendedFsmService Interface

```c++
interface ExtendedFsmService : SDOPackage::SDOService {
    string get_current_state();
    ReturnCode_t set_fsm_structure(in FsmStructure fsm_structure);
    ReturnCode_t get_fsm_structure(out FsmStructure fsm_structure);
}
```

7.3.7 Data Port

7.3.7.1 DataPushService Interface

```c++
interface DataPushService {
    PortStatus push(in OctetSeq data);
}
```

7.3.7.2 DataPullService Interface

```c++
interface DataPullService {
    PortStatus pull(out OctetSeq data);
}
```
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Annex A: OMG IDL

(normative)

A.1 ComponentObserver.idl

```
#ifndef _COMPONENT_OBSERVER_IDL_
#define _COMPONENT_OBSERVER_IDL_

#include <SDOPackage.idl>

#pragma prefix "omg.org"

module RTC {
	enum StatusKind {

        COMPONENT_PROFILE,
        RTC_STATUS,
        EC_STATUS,
        PORT_PROFILE,
        CONFIGURATION,
        RTC_HEARTBEAT,
        EC_HEARTBEAT,
        FSM_PROFILE,
        FSM_STATUS,
        FSM_STRUCTURE,
        USER_DEFINED,
        STATUS_KIND_NUM
    };

#pragma version StatusKind 1.0

interface ComponentObserver : SDOPackage::SDOService
```
{  
oneway void update_status(in StatusKind status_kind,  
                           in string     hint);  
};
#pragma version ComponentObserver 1.0
};
#undef _COMPONENT_OBSERVER_IDL_

A.2 ExtendedFsmService.idl

#ifndef _EXTENDED_FSM_SERVICE_IDL_
#define _EXTENDED_FSM_SERVICE_IDL_

#include <RTC.idl>

#pragma prefix "omg.org"

module RTC  
{
    struct FsmEventProfile  
    {  
        string name;  
        string data_type;  
    };  
#pragma version FsmEventProfile 1.0  
typedef sequence<FsmEventProfile> FsmEventProfileList;

    struct FsmStructure  
    {  
        string name;  
        string structure;  
        FsmEventProfileList event_profiles;  
        NVList properties;  
}
interface ExtendedFsmService : SDOPackage::SDOService
{
    string get_current_state();
    ReturnCode_t set_fsm_structure(in FsmStructure fsm_structure);
    ReturnCode_t get_fsm_structure(out FsmStructure fsm_structure);
};
#pragma version ExtendedFsmService 1.0

#endif // _EXTENDED_FSM_SERVICE_IDL_

A.3  DataPort.idl

#ifndef _DATA_PORT_IDL_
#define _DATA_PORT_IDL_

#pragma prefix "omg.org"

module RTC
{
    enum PortStatus
    {
        PORT_OK,
        PORT_ERROR,
        BUFFER_FULL,
        BUFFER_EMPTY,
        BUFFER_TIMEOUT,
        UNKNOWN_ERROR
    };
    #pragma version PortStatus 1.0

typedef sequence<octet> OctetSeq;
interface DataPushService
{
  PortStatus push(in OctetSeq data);
};
#pragma version DataPushService 1.0

interface DataPullService
{
  PortStatus pull(out OctetSeq data);
};
#pragma version DataPullService 1.0

#endif // _DATA_PORT_IDL_
Annex B: References

(non-normative)

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