Connected Home Appliances – Object Modeling

ANSI/AHAM CHA-1-2003 (R2007)

Approved American National Standard

ANSI

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PREFACE

The Association of Home Appliance Manufacturers develops standards in accordance with AHAM's "Policy and Procedures Governing Technical Standards", which states:

“AHAM Standards shall be in the best interest, mutually, of consumers who use appliances, and other properly interested parties.”

AHAM standards are presented to the American National Standards Institute (ANSI) for recognition as American National Standards. This standard was so recognized on October 31, 2007 and bears the American National Standard designation ANSI/AHAM CHA-1-2003 (R2007). This edition supersedes ANSI/AHAM CHA-1-2003.

With regard to safety, AHAM recommends that all appliance products--both major and portable--manufactured or marketed in the United States be submitted to an appropriate independent laboratory for inspection and listing in conformance with the safety standards and procedures followed by such laboratories.

AHAM welcomes comments and suggestions regarding this standard. Any standard may be reviewed and improved as needed. All standards must be updated or reconfirmed at least every five years. Any interested party, at any time, may request a change in an AHAM standard. Such request should be addressed to AHAM's President, and should be accompanied by a statement of reason for the request and a suggested alternate proposal.

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TABLE OF CONTENTS

1. PURPOSE 1
2. SCOPE 2
3. DEFINITIONS 3
4. GENERAL APPROACH TO MODELING APPLIANCES 4
   4.1. Objects and Methods 4
   4.2. Commands and Events 4
   4.3. Object Classes 5
   4.4. Methods 5
   4.5. Event Messages 6
   4.6. Appliance State Names 6
   4.7. Notes for Appliance Models 7
   4.8. Structure and Hierarchy of Appliance Models 8
   4.9. Manufacturer Extensions 8
5. Clothes Washer Appliance Model 10
   5.1. DEVICE DESCRIPTION SUBSYSTEM (REQUIRED) 11
   5.2. USER CONTROL SUBSYSTEM (REQUIRED) 13
   5.3. OPERATION MONITORING SUBSYSTEM (REQUIRED) 16
6. Refrigerator-Freezer Appliance Model 20
   6.1. DEVICE DESCRIPTION SUBSYSTEM (REQUIRED) 21
   6.2. MAIN COMPARTMENT SYSTEM (REQUIRED) 22
   6.3. AUXILIARY COMPARTMENT SYSTEM 28
   6.4. ICE MAKER/DISPENSER SYSTEM 31
7. Clothes Dryer Appliance Model 36
   7.1. DEVICE DESCRIPTION SUBSYSTEM (REQUIRED) 37
   7.2. USER CONTROL SUBSYSTEM (REQUIRED) 39
   7.3. OPERATION MONITORING SUBSYSTEM (REQUIRED) 41
8. Dishwasher Appliance Model 45
   8.1. DEVICE DESCRIPTION SUBSYSTEM (REQUIRED) 46
   8.2. USER CONTROL SUBSYSTEM (REQUIRED) 48
   8.3. OPERATION MONITORING SUBSYSTEM (REQUIRED) 49
9. Range, Oven, Cooktop Appliance Model 55
   9.1. DEVICE DESCRIPTION SUBSYSTEM (REQUIRED) 56
   9.2. OVEN SYSTEM 58
   9.3. COOK TOP SYSTEM 64
10. Countertop Microwave Oven Appliance Model 71
   10.1. DEVICE DESCRIPTION SUBSYSTEM (REQUIRED) 72
   10.2. USER CONTROL SUBSYSTEM (REQUIRED) 74
   10.3. OPERATION MONITORING SUBSYSTEM (REQUIRED) 78
11. Room Air Conditioner (Window Type) Appliance Model 81
   11.1. DEVICE DESCRIPTION SUBSYSTEM (REQUIRED) 82
   11.2. USER CONTROL SUBSYSTEM (REQUIRED) 83
   11.3. OPERATION MONITORING SUBSYSTEM (REQUIRED) 86

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LIST OF FIGURES

Figure No.	Title	Page
4-1	A Message to an Object Involves A Method	4
4-2	Commands and Events as Alternate Message Types	4
4-3	Virtual State Indicators	7
4-4	Structure/Hierarchy of Appliance Models	8
4-5	AHAM Appliance Model Hierarchy	9
5-1	AHAM Appliance Model of Clothes Washer	10
6-1	AHAM Appliance Model of Refrigerator-Freezer	20
7-1	AHAM Appliance Model of Clothes Dryer	36
8-1	AHAM Appliance Model of Dishwasher	45
9-1	AHAM Appliance Model of Range, Oven, Cooktop	55
10-1	AHAM Appliance Model of Countertop Microwave Oven	71
11-1	AHAM Appliance Model of Room Air Conditioner	81

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INTRODUCTION

AHAM formed a Smart Appliance Task Force in August of 2000 to investigate the standardization of the messaging aspects of connected home appliances. The initial focus was to develop a voluntary consensus standard to facilitate the interoperability of "smart" appliances at the interface between the appliance and the communications network.

Extensive discussions were held to investigate a complete communications standard, including all seven layers of the Open System Interconnection (OSI) reference model, from the physical layer up through the application layer. The OSI model is a widely recognized framework standard for transmitting messages between two points in a telecommunications network.

Comments on the initial approach of the task force were solicited from several network providers in May of 2001. After consideration of their feedback on various architecture schemes, physical layer protocols, and hardware implementations, the task force determined that it was preferable to take a high level, generic approach and defer more detailed considerations to possible future efforts. Therefore, the mission of the task force was redefined to include the following aspects:

1. Interoperability is based on generic appliance models, objects, and high-level messages, which will allow for mapping to various protocols.
2. The abstract AHAM models are not directly coupled to an end product.
3. Manufacturers will map the AHAM features and functions to their product.

The task force adopted the following ground rules:

- Focus on the standard (required) behavior
- Determine what is controllable and observable for typical products in the market
- Only 1 interface per behavior
- Work in English, verses a programming language, to avoid implementation-specific details
- Optional elements can be added in the future

The work product from this effort is documented herein as the standard. Opportunities for future work phases may include the following:

- Extend interoperability with new capabilities including:
  - standardized models for service/diagnostics
  - standardized models for energy management
  - additional appliance categories
- Specify a communications protocol for all relevant layers of the OSI Reference model

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1. PURPOSE

The purpose of this standard is to promote new appliance services and features enabled through networking by describing generic appliance models, objects, and high-level messages. The models define standardized elements of appliances that are accessible and controllable remotely by users, service providers, and other devices, independent of the underlying network.

This document assumes that each appliance and device contains a communications interface module linked to a home systems network.

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2. SCOPE

This standard provides a template that is to be used for documenting generic appliance models, objects, and high-level messages and future extensions.

Appliances are described as collections of subsystems that are modeled as objects. High-level messages are defined for accessing object properties and for executing methods within the objects. The standard consists of required and optional messages and objects. Extensions may be defined by manufacturers for private use.

The interface, transport mechanism, and coding (fields and bits) of messages are beyond the scope of this document.

The initial version of this standard describes models and objects applicable to the following appliances:

1. Clothes Washer
2. Refrigerator-Freezer
3. Clothes Dryer
4. Dishwasher
5. Range , Oven, Cooktop
6. Countertop Microwave Oven
7. Room Air-Conditioner (window type)

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3. DEFINITIONS

Appliance Model – An abstract representation of the functionality of an appliance created to facilitate networking of appliances.

Control Object – An object for modeling an actuator or control panel switches and keys on a device. A message sent to a Control Object usually changes an internal state of the device.

Device – One of a limited set of appliances for which AHAM appliance models have been developed, e.g., a range, a microwave, etc. Refer to the appliance list in section 2 - Scope.

Indicator Object – An object for modeling a sensor or control panel displays on a device. A message sent to an Indicator Object usually queries an internal state of the device.

Instantiation – The process of creating an object from an object class for use in an appliance model.

Object – An abstract element representing device functions and data stored within the device. The functions and data contained within an object (referred to as *properties*) can be executed, read, or modified as appropriate for the property by messages sent from other objects.

Object Class – An object class is the design template that is used as the basis for instantiating an object. An object class consists of functions and properties. All or a subset of the properties may be included in each object that is instantiated from a particular object class.

Object Container – A collection of logically related objects.

Object Properties – Data elements contained within an object.

REQUIRED – For the purposes of this standard, items in subsystems, object containers, objects or object properties that are marked REQUIRED shall be implemented if the level immediately above it (system, subsystem, object container or object respectively), whether optional or required, is implemented. See Figures 4.4 and 4.5 for the AHAM Appliance Model Hierarchy. For example, if a given object container (whether optional or required) is implemented, then any required objects within that object container must be implemented along with any required object properties within those required objects. Additionally, if in this example, an optional object within the object container is also implemented, then any required properties within that object must also be implemented. This ensures that for a given implementation, developers will be guaranteed a minimum level of functionality. Provisions not marked REQUIRED are considered optional.

Subsystem – AHAM defined term for parts of a device. Subsystems may be further grouped into systems in more complex devices. An example of a subsystem as used herein is the User Control Subsystem.

System – AHAM defined term for the major parts of a device as defined in this standard; e.g., the cook top portion and the oven portion of a range device are systems. Not all devices are subdivided into systems.

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4. GENERAL APPROACH TO MODELING APPLIANCES

4.1. Objects and Methods

A key objective in defining a set of messages is to reuse language elements where possible. Object-oriented design facilitates code and data reuse, thereby reducing costs for manufacturers. It was created about 10 years ago for computer programs. The structure of object-oriented design is relatively simple and powerful. A *Message*, possibly carrying properties, is sent to an *Object*. The Message causes a *Method* within the Object to be invoked, as shown in Figure 4.1. This may result in access to an internal data structure or the execution of a subroutine or both. A value may be returned by the recipient Object.

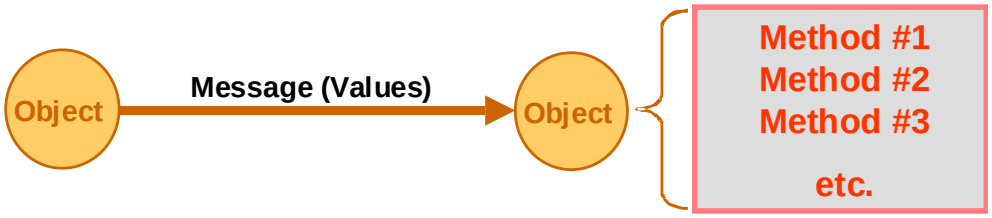

Figure 4.1 – A Message to an Object Invokes a Method

4.2. Commands and Events

Both *Commands* and *Events* use Messages, as shown in Figure 4.2. Commands are used for remote control of equipment. The recipient may provide a status report in response. An Event is issued by an object typically when a controller or operator needs to be informed about a significant change or alarm.

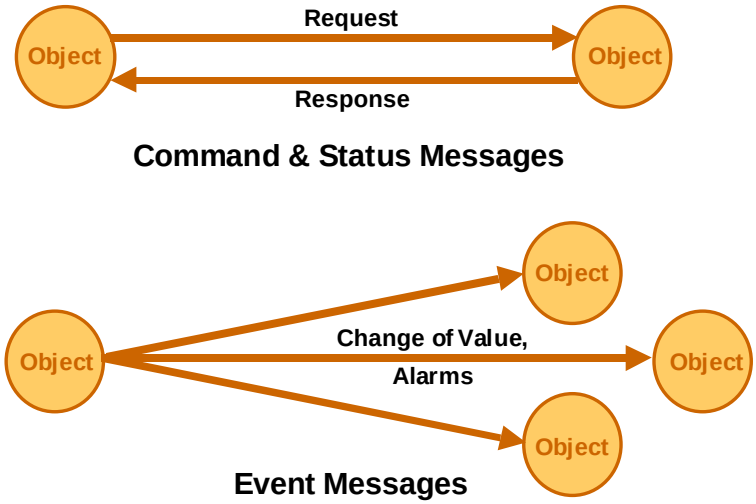

Figure 4.2 – Commands and Events as Alternate Message Types

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4.3. Object Classes

Each AHAM appliance is modeled as a collection of objects. The objects for the AHAM appliance models are organized into the subsystems illustrated in the figures at the beginning of each appliance specific chapter. The objects are instantiated from the following object classes:

- **Device Information**
  (multiple text records)
- **Discrete Control**
  (sets a value within a specified range; range, units, and precision to be defined)
- **Discrete Indicator**
  (senses a value within a specified range; range, units, and precision to be defined)
- **Binary Control**
  (sets one of two states)
- **Binary Indicator**
  (indicates value of one of two states)
- **Multifunction Control**
  (selects one of N values)
- **Multifunction Indicator**
  (senses one of N values)
- **Timer Control**
  (settable interval time not related to clock time; GetValue can return original set value as well as the current value which includes a setting for indeterminate time)
- **Timer Indicator**
  (interval time not related to clock time; GetValue returns the current value which includes a setting for indeterminate time)
- **Clock Time Control**
  (clock time is time of day; it may include calendar time)

The objects for each subsystem in the AHAM Models are presented in Chapters 5 through 11.

4.4. Methods

The following methods are supported by these object classes.

- **GetValue**
- **SetValue**
- **SetOn**
- **SetOff**

Following is the meaning of each method:

- **GetValue**
  (applies to all object classes)

  A message requesting the GetValue method is addressed to one or more properties in one or more objects within the appliance. This method returns the value(s) of the specified properties. The value(s) returned reflects the current state of the appliance regardless of whether the underlying values were set by

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the requesting device or controller, another device or controller, or a user interface incorporated within the appliance.

- **SetValue**
(applies to all control object classes and nickname under Product Information Object)

A message requesting the SetValue method is addressed to one or more properties in one or more objects within the appliance. This method writes the value(s) carried in the message to the specified object properties.

- **SetOn**
(applies to the Binary Control object)

A message requesting the SetOn method is addressed to one or more properties in one or more Binary Control objects within the appliance. This method activates the ON definition of a Binary Control object. If the Binary Control object is already in the ON state, then no message need be sent.

- **SetOff**
(applies to the Binary Control object)

A message requesting the SetOff method is addressed to one or more properties in one or more Binary Control objects within the appliance. This method activates the OFF definition of a Binary Control object. If the Binary Control object is already in the OFF state, then no message need be sent.

This standard does not define the properties and related specifications for each object. However, please note that the key property in each control and indicator object is the "current value." This property is read/write for a control object and read-only for an indicator object.

4.5. Event Messages

All objects may issue event messages. Manufacturers will determine the thresholds for each event if not stated herein. An event is a message issued by an object when it changes state or when a change in an object property exceeds a specified value or range of values. Manufacturers are not required to implement event management.

In an actual implementation a polling/poll rate mechanism that returns the changed value may substitute for an event mechanism. Some communication systems may support specific options for subscribing to messages such as: Binding, Polling Rate, Priority, Encryption, etc.

When a formal event mechanism is supported, the following method allows one device to subscribe to event notification (make a prior request for notification) from an object in a second device.

- **EventSubscription**
A message requesting the EventSubscription method is addressed by a “subscribing appliance” to an object. That object must be preprogrammed to issue event messages when a specified property changes or exceeds a specified value or range. The event message is then issued by the object as an asynchronous, unsolicited message to the subscribing appliance.

4.6. Appliance State Names

Typically a state transition occurs when an appliance starts, stops or is interrupted from its normal process cycle. State Transition objects allow an external device communicating with an appliance model to request a state change within an

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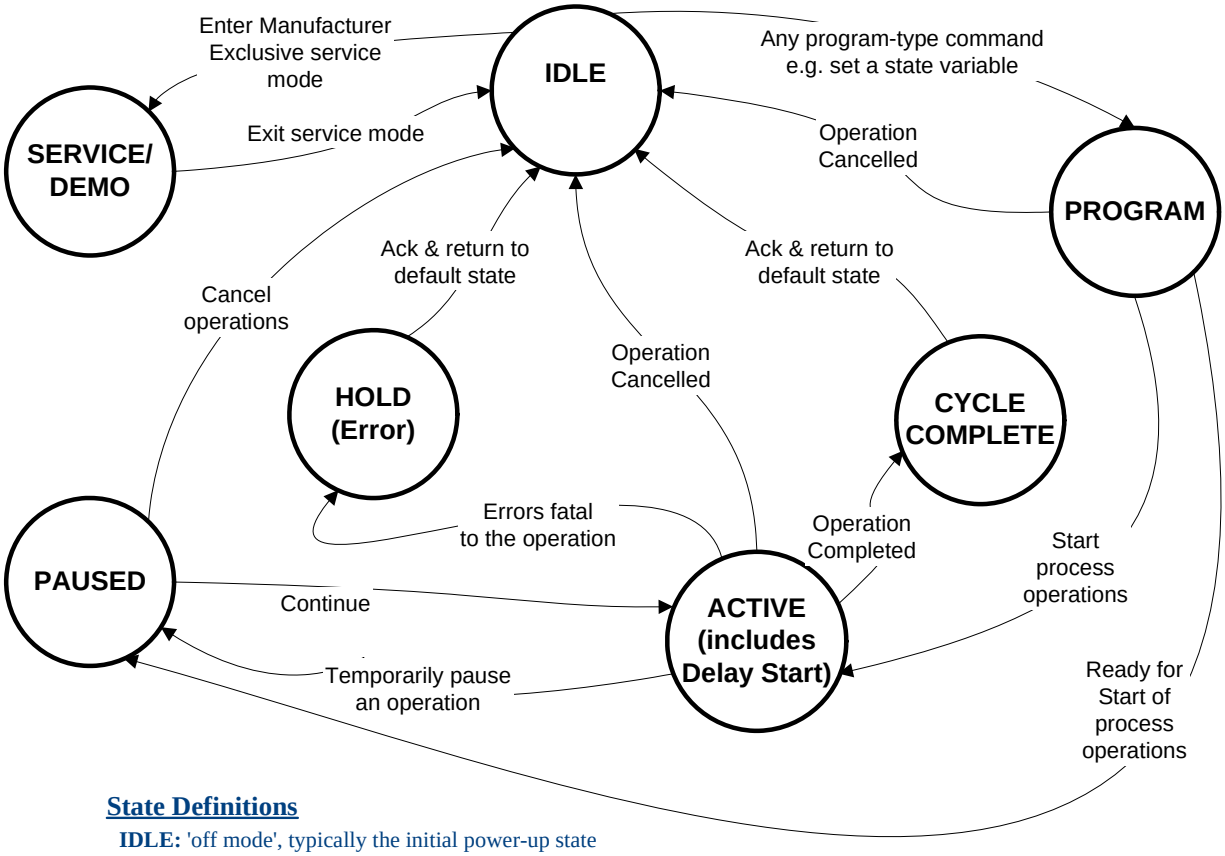
appliance. A requested state change may or may not occur, depending on interlocks incorporated at the physical appliance. The appliance state names used in this document are shown in Figure 4.3.



State Definitions

IDLE: 'off mode', typically the initial power-up state
PROGRAM: The machine is receiving instructions to define a process, but no start has been received
ACTIVE: The machine is currently executing a process (e.g. during a wash or cook cycle)
PAUSE: The machine was paused (by user or network)
HOLD: A severe error has occurred that has cancelled the operation (does not include standard non-fatal errors)
CYCLE COMPLETE: The machine completed a process, but has not returned to the IDLE state
SERVICE/DEMO: The machine is running proprietary manufacture-specific service and diagnostic functions

Figure 4-3 –Virtual State Indicators

4.7. Notes for Appliance Models

The following notes apply to all of the device/appliance models described in Chapters 5-11:

1) The Object Model describes the behavior of a virtual appliance with respect to features that may be communicated. It is not intended to describe the physical implementation of any manufacturer's appliance. It is the responsibility of the manufacturer to ensure the appliance is designed to operate safely.
2) • "Bullets" followed by bold text indicate the name of an object.
3) ❖ "Stars" followed by text indicate a property of an object.
4) For the purposes of this standard, items in subsystems, object containers, objects or object properties that are marked REQUIRED shall be implemented if the level immediately above it (system, subsystem, object container or object respectively, whether optional or required) is implemented. See Figures 4.4 and 4.5 for the AHAM

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Appliance Model Hierarchy. For example, if a given object container (whether optional or required) is implemented, then any required objects within that object container must be implemented along with any required object properties within those required objects. Additionally, if in this example, an optional object within the object container is also implemented, then any required properties within that object must also be implemented. This ensures that for a given implementation, developers will be guaranteed a minimum level of functionality. Provisions not marked REQUIRED are considered optional.

4.8. Structure and Hierarchy of Appliance Models

The structure, or hierarchy, of each appliance model as detailed in the following chapters is illustrated in Figures 4.4 and 4.5.

X. Device (Appliance) Object Model

X.Y. System

X.Y.Z. Subsystem

X.Y.Z.1 Object Container

- Object

❖ Properties

Figure 4-4 - Structure/Hierarchy of Appliance Models

Only devices that provide more than one primary function will have a "system" level. For example, a range consists of oven and cook top systems. However, a dishwasher does not have a system level, rather just subsystems. For devices without a system level, the subclass numbering illustrated in Figure 4.4 will contain one less decimal.

4.9. Manufacturer Extensions

Manufacturers may add additional features that may not be made public. They may define additional object instantiations within the existing subsystems or may add new subsystems to the AHAM models. Provision has been made in the Device Description subsystem for manufacturers to provide data about private features. The objective of this standard is to facilitate interoperation among appliances. Manufacturers are encouraged to share their additions with the industry through AHAM.

Models created by manufacturers that are not one of the seven product models listed in the scope should be classified as “other” in the AHAM appliance model property identified in the Product Information Object.

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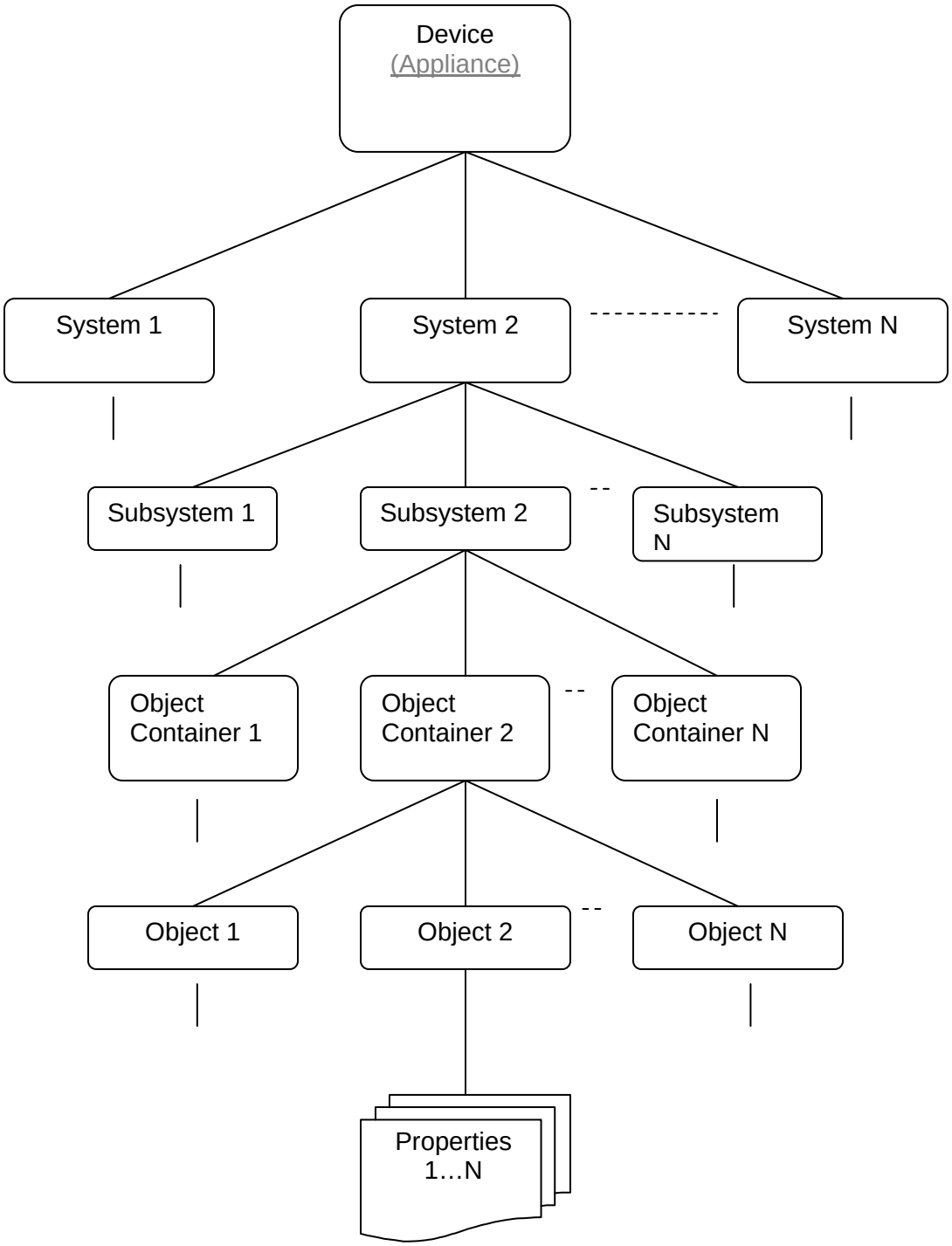

Figure 4-5 - AHAM Appliance Model Hierarchy

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5. Clothes Washer Appliance Model

This chapter defines an object model of a generic interface for a household clothes washer. Figure 5-1 below is a diagram of the Clothes Washer Appliance Model. See Section 4.7 for NOTES applicable to all appliance models.

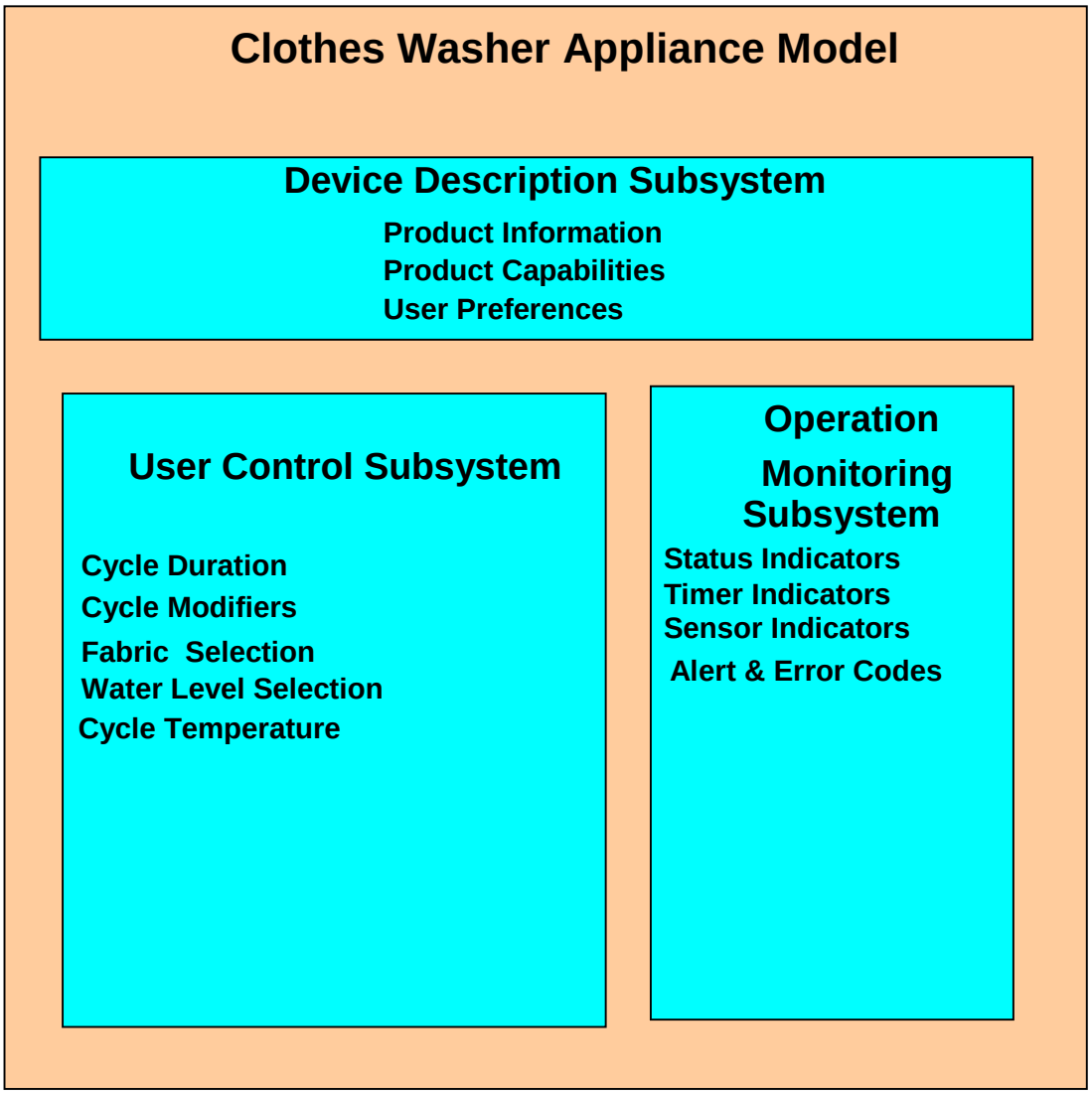

Figure 5.1 – AHAM Appliance Model of Clothes Washer

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5.1. DEVICE DESCRIPTION SUBSYSTEM (REQUIRED)

The Device Description Subsystem provides information of a general nature about the appliance and a place for objects that are not part of any single system within an appliance.

5.1.1. Product Information Object Container (REQUIRED)

Product information object provides information similar to that found on the nameplate of a physical appliance.

- **Product Information Object (REQUIRED)**

  This object is instantiated from the Device Information Class. The Product Information Object consists of multiple text records. The content of these records is given as follows:

  - AHAM appliance model (clothes washer): **(REQUIRED)**
  - Nick Name (Get/Set)
    User defined name of appliance (e.g. bedroom washer)
  - Manufacturer name: **(REQUIRED)**
  - Manufacturer model: **(REQUIRED)**
  - Product serial number
  - Device Online/Offline
    Indicates if device is connected or disconnected from network.
  - Reserved for future Conformance Level definition
    AHAM Specification property identifying appliance capabilities.

5.1.2. Product Capabilities Object Container (REQUIRED)

The AHAM appliance models include required and optional objects and properties. Therefore, there are likely to be many versions of each appliance type (range, dryer, etc.) that conform to the AHAM standard. The purpose of the Product Capabilities Object is to enable an external device to establish effective communications with a target appliance. The Product Capabilities Object lists the specific objects and properties implemented in the target appliance. An external device can read the Product Capabilities Object to discover the features and services supported by that appliance.

- **Product Capabilities Object (REQUIRED)**

  This object is instantiated from the Device Information Class. This object contains a list of each object and associated object properties, including any manufacturer specific objects, implemented in the appliance.

  The format of the Product Capabilities Object depends on the specification of the communications protocol with which this appliance model is implemented. A reference implementation of the Product Capabilities Object consists of multiple text records.

  In the reference implementation each text record contains the path to each object implemented and the properties supported by that object. This means that each record should contain the names of the following model elements:

  System (if any), Subsystem, Object Container, Object, and Object Properties supported by that object

  Each name should be placed in quotations and comma-delimited, with the exception of the property list, which should be preceded by a semi-colon instead of a comma (to help the parser distinguish between a

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system name and the first property, since the system level is optional). A colon should terminate each record.

5.1.3. User Preferences Object Container

This container consists of objects that do not affect the actual appliance operation, but do affect peripheral functions of the appliance.

- **SI Units Mode Object**

This object is instantiated from the Binary Control Class. It selects the units (degrees C or F) the appliance will use when displaying temperature.

  - TRUE= Display temperatures in degrees C
  - FALSE= Display temperatures in degrees F

- **Language Preference Object**

This object is instantiated from the Multifunction Control Class to select the language used by the appliance. The selections identified for this object are listed below:

  - English
  - Spanish
  - French
  - Etc.
  - None (No selection made)

- **Audio Enable Object**

This object is instantiated from the Binary Control Class. The Audio Enable control is used to enable or disable all local audio indicators at the appliance. The states for this object are defined as:

  - TRUE = Audio Devices Enabled
  - FALSE = Audio Devices Disabled

- **Audio Volume Object**

This object is instantiated from the Discrete Control Class. The Audio Volume Object determines the volume, or loudness, of all local audio indicators at the appliance.

- **Demo Mode Object**

This object is instantiated from the Binary Control Class. It is used to place the appliance into a demonstration mode typically used for in-store use.

  - TRUE= Demo mode
  - FALSE= Normal operation

- **Service/Diagnostic Mode Object**

This object is instantiated from the Binary Control Class.

  - TRUE= Enable manufacturer-specific service or diagnostic mode algorithm
  - FALSE= Normal operation

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- **Lock Out Object**

This object is instantiated from the Binary Control Class. The Lock Out control is used to enable or disable the user interface. The states for this object are defined as:

  - TRUE = Locked
  - FALSE = Unlocked / System is Useable

5.2. USER CONTROL SUBSYSTEM (REQUIRED)

The User Control subsystem defines the interface elements necessary to setup and initiate a wash cycle with a remote device. All User Control Objects respond to read and write messages and can issue event messages.

5.2.1. Cycle Duration Object Container (REQUIRED)

(Wash Cycle related to Soil level)

- **Wash Cycle Object** **(REQUIRED)**

This object is instantiated from the Multifunction Control Class. The Wash Cycle Object selects the duration of the wash cycle.

  - Extra Heavy
  - Heavy **(REQUIRED)**
  - Heavy Normal
  - Normal **(REQUIRED)**
  - Light Normal
  - Light **(REQUIRED)**
  - Extra Light
  - Rinse
  - Spin
  - Soak
  - Stain
  - Special (quick, fast …)
  - None (No selection made)

5.2.2. Cycle Modifiers Object Container (REQUIRED)

Cycle modifiers initiate state changes of the appliance or determine optional activities for the Wash Cycle.

- **Spin Speed Object**

This object is instantiated from the Discrete Control Class. The Spin Speed object determines the Spin Speed.

- **Extra Spin Object**

This object is instantiated from the Binary Control Class. The Extra Spin object increases the Spin cycle by an amount determined by the manufacturer.

  - TRUE= Extra Spin
  - FALSE= Normal Spin

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- **Extra Rinse Object**

This object is instantiated from the Binary Control Class. The Extra Rinse object adds a rinse cycle.

  - TRUE= Extra Rinse
  - FALSE= Normal Rinse

- **Pre-Wash Object**

This object is instantiated from the Binary Control Class. The Pre-Wash object adds a Pre-Wash cycle.

  - TRUE= Pre-Wash
  - FALSE= No Pre-Wash

- **Start Cycle Object**

This object is instantiated from the Binary Control Class. The Start Cycle object initiates a cycle at the physical appliance. This control is similar to the start button at the physical appliance, however additional safety-interlocks may be required for remote operation. Figure 4-3. A manufacturer may choose not to implement remote start capabilities. The states for this object are defined as:

  - TRUE = Start request
  - FALSE = No pending request

- **Ready for Start Object** **(REQUIRED)**

This object is instantiated from the Binary Control Class. The Ready for Start object causes the appliance model to move from the Program State to the Paused State as illustrated in Figure 4-3. This control provides a normal conclusion to the setup or programming activities without starting the appliance. This control may be used when remote start of an appliance is not desirable while nevertheless providing remote configuration of other cycle properties. The states for this object are defined as:

  - TRUE = Ready for start
  - FALSE = No pending action

- **Pause Cycle Object**

This object is instantiated from the Binary Control Class. The Pause Cycle object interrupts the normal cycle at the physical appliance and causes the appliance to move from the active state to the paused state as shown in Figure 4-3. The states for this object are defined as:

  - TRUE = Pause
  - FALSE = No pending action

- **Cancel Cycle Object** **(REQUIRED)**

This object is instantiated from the Binary Control Class. The Cancel Cycle object interrupts the normal cycle at the physical appliance and causes the appliance to move from the current state to the idle state as shown in Figure 4-3. The states for this object are defined as:

  - TRUE = Cancel
  - FALSE = No pending action

- **Delayed Start Duration Object**

This object is instantiated from the Timer Control Class. The Delayed Start Duration object determines the amount of delay prior to starting the washer. It is interval time and not related to clock time.

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5.2.3. Fabric Selection Object Container (REQUIRED)

(Material often dictates the speed and aggressiveness of wash)

- **Fabric or Speed Object** **(REQUIRED)**

This object is instantiated from the Multifunction Control Class. It selects the aggressiveness of the wash, speed of water extraction and may affect additional manufacturers' properties.

- Very Fast (Cotton Sturdy)
- Fast (Cotton) **(REQUIRED)**
- Fast Normal
- Normal (Wrinkle-free) **(REQUIRED)**
- Light Normal
- Slow (Delicate) **(REQUIRED)**
- Very Slow (Hand Wash)
- Intermittent Slow
- Intermittent Very Slow
- None (No selection made)

5.2.4. Water Level Selection Object Container (Load Size) (REQUIRED)

- **Water Level or Load Size Object** **(REQUIRED)**

This object is instantiated from the Multifunction Control Class. It selects the water level / load size.

- Auto Sense
- Very Large Load
- Large Load **(REQUIRED)**
- Medium Load **(REQUIRED)**
- Small Load **(REQUIRED)**
- Very Small Load
- None (No selection made)

5.2.5. Cycle Temperature Object Container (Wash/Rinse) (REQUIRED)

- **Water Temperature Object** **(REQUIRED)**

This object is instantiated from the Multifunction Control Class. It selects the desired temperature of the wash and rinse cycles.

- Hot/Hot
- Hot/Warm
- Hot/Cold **(REQUIRED)**
- Warm/Warm
- Warm/Cold **(REQUIRED)**
- Cold/Cold **(REQUIRED)**
- None (No selection made)
- Default (Determined by manufacturers' algorithm. Should return machine internal selection for temperature.)

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5.3. OPERATION MONITORING SUBSYSTEM (REQUIRED)

Sensor data and other non-control functions. All data is one-way coming from the appliance (indicator objects). Unless otherwise noted, all Operation Monitoring Objects respond to read messages, and can issue event messages. Objects indicate the state of system operation, sensor readings, timers, and status indicators.

5.3.1. Status Indicators Object Container (REQUIRED)

The Status Indicators provide information about what is happening within the appliance.

- **Virtual State Object** **(REQUIRED)**

This object is instantiated from the Multifunction Indicator Class. The Virtual State Indicator object represents the operational state of the physical appliance as shown in Figure 4.3. The states identified for this object are listed below:

- ❖ Idle (Standby) **(REQUIRED)**
- ❖ Program **(REQUIRED)**
- ❖ Active **(REQUIRED)**
- ❖ Paused **(REQUIRED)**
- ❖ Cycle Complete **(REQUIRED)**
- ❖ Hold (error, cycle cancelled conditions) **(REQUIRED)**
- ❖ Service **(REQUIRED)**

- **Cycle Step Indicator Object** **(REQUIRED)**

This object is instantiated from the Multifunction Indicator Class. The Cycle Step Indicator object provides information about the progression of the washing cycle. The states identified for this object are listed below:

- ❖ Inactive **(REQUIRED)**
- ❖ Delay Start
- ❖ Fill **(REQUIRED)**
- ❖ Wash (Agitate, Tumble, etc) **(REQUIRED)**
- ❖ Drain **(REQUIRED)**
- ❖ Rinse **(REQUIRED)**
- ❖ Spin **(REQUIRED)**

- **Change Filter Object**

This object is instantiated from the Binary Indicator Class. It indicates the water filter requires changing.

- ❖ TRUE= Filter requires changing
- ❖ FALSE= Filter does not require changing

- **Unbalanced Load Object**

This object is instantiated from the Binary Indicator Class. It indicates the wash load is unbalanced.

- ❖ TRUE= Load is unbalanced
- ❖ FALSE= No abnormal condition detected

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- **Reversed Hoses Object**

This object is instantiated from the Binary Indicator Class. It indicates the hot and cold water feed hoses are reversed.

  - TRUE= Hoses are reversed
  - FALSE= No abnormal condition detected

- **Slow Drain Object**

This object is instantiated from the Binary Indicator Class. It indicates a potential drain blockage causing the water to drain slowly.

  - TRUE= Water is draining slowly
  - FALSE= No abnormal condition detected

- **No Fill Object**

This object is instantiated from the Binary Indicator Class. It indicates the Washer did not fill with water.

  - TRUE= Water did not fill
  - FALSE= No abnormal condition detected

- **Low Line Voltage Object**

This object is instantiated from the Binary Indicator Class. The Low Line Voltage Object indicates that a low line voltage condition has been detected at the appliance. The states for this object are defined as:

  - TRUE = Low line voltage detected
  - FALSE = Line voltage is normal

- **Power Failure Detected Object**

This object is instantiated from the Binary Indicator Class. The Power Failure Detected Object indicates that a power failure condition has been detected at the appliance. The states for this object are defined as:

  - TRUE = Power Failure detected
  - FALSE = No power failure detected

- **Open Drain Valve Object**

This object is instantiated from the Binary Indicator Class. It indicates the drain valve is open when it should be closed.

  - TRUE= Drain valve open
  - FALSE= No abnormal condition detected

- **Temperature Not Achieved Object**

This object is instantiated from the Binary Indicator Class. It indicates the desired temperature was not reached within a manufacturer determined time. This may result from bad heating element.

  - TRUE = Unable to regulate temperature to within specified limits
  - FALSE = OK

- **Stalled Motor Object**

This object is instantiated from the Binary Indicator Class. The Stalled Motor Object indicates that the drive motor in the appliance is unable to operate properly. The states for this object are defined as:

  - TRUE = Abnormal drive motor operation detected.
  - FALSE = No abnormal condition detected.

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- **Service Needed Object**

This object is instantiated from the Binary Indicator Class. The Service Needed Object indicates a condition requiring a service technician is detected. The states for this object are defined as:

  - TRUE = A condition requiring service is detected.
  - FALSE = No abnormal condition detected.

5.3.2. Timer Indicators Object Container

- **Cycle Time Remaining Object**

This object is instantiated from the Timer Indicator Class. The Cycle Time Remaining Object indicates the remaining time for the current washing cycle. This value may be actual remaining time when a Time-wash cycle is selected or the estimated remaining time when a Sensor-wash cycle is selected. The remaining time value is given as a time interval.

- **Cycle Time Elapsed Object**

This object is instantiated from the Timer Indicator Class. The Cycle Time Elapsed Object indicates the elapsed time for the current washing cycle. The elapsed time value is given as a time interval.

- **Step Time Remaining Object**

This object is instantiated from the Timer Indicator Class. The Step Time Remaining Object indicates the remaining time for the current step of the washing cycle. This value may be actual remaining time when a Time-wash cycle is selected or the estimated remaining time when a Sensor-wash cycle is selected. The remaining time value is given as a time interval.

- **Step Time Elapsed Object**

This object is instantiated from the Timer Indicator Class. The Step Time Elapsed Object indicates the elapsed time for the current step within the washing cycle. The elapsed time value is given as a time interval.

5.3.3. Sensor Indicators Object Container (REQUIRED)

Sensor Indicators provide information about physical properties measured or detected by the appliance.

- **Door Closed Object (REQUIRED)**

This object is instantiated from the Binary Indicator Class. The Door Closed Object provides confirmation that the door on the physical appliance is closed as sensed by the door switch. The states for this object are defined as:

  - TRUE = The door is closed.
  - FALSE = The door closed condition is not detected.

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- **Door Locked Object**

This object is instantiated from the Binary Indicator Class. It indicates the state of the door lock of the washer.

  - TRUE= Door is locked
  - FALSE= Door is unlocked

- **Water Temperature Object**

This object is instantiated from the Discrete Indicator Class. It indicates the temperature of the water.

- **Water Level Object** **(REQUIRED)**

This object is instantiated from the Discrete Indicator Class. It indicates the level of the water in the washer at the time the object is read.

- **Spin Speed Object**

This object is instantiated from the Discrete Indicator Class. It indicates the spin speed in RPM.

- **Load Size Object**

This object is instantiated from the Discrete Indicator Class. It indicates the size of the load.

5.3.4. Alert and Error Codes Object Container (REQUIRED)

Alert and Error Code Objects allow an appliance to transmit messages regarding abnormal circumstances to an external device.

- **Cannot Execute Command Object** **(REQUIRED)**

This object is instantiated from the Device Information Class. The Can Not Execute Command Object is a text message transmitted when an appliance is unable to execute a command from a remote device. The format of this message is given as follows:

  - Cannot execute command + <optional text> **(REQUIRED)**

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6. Refrigerator-Freezer Appliance Model

This chapter defines an object model of a generic interface for a household refrigerator-freezer. Figure 6-1 below is a diagram of the Refrigerator-Freezer Appliance Model. See Section 4.7 for NOTES applicable to all appliance models.

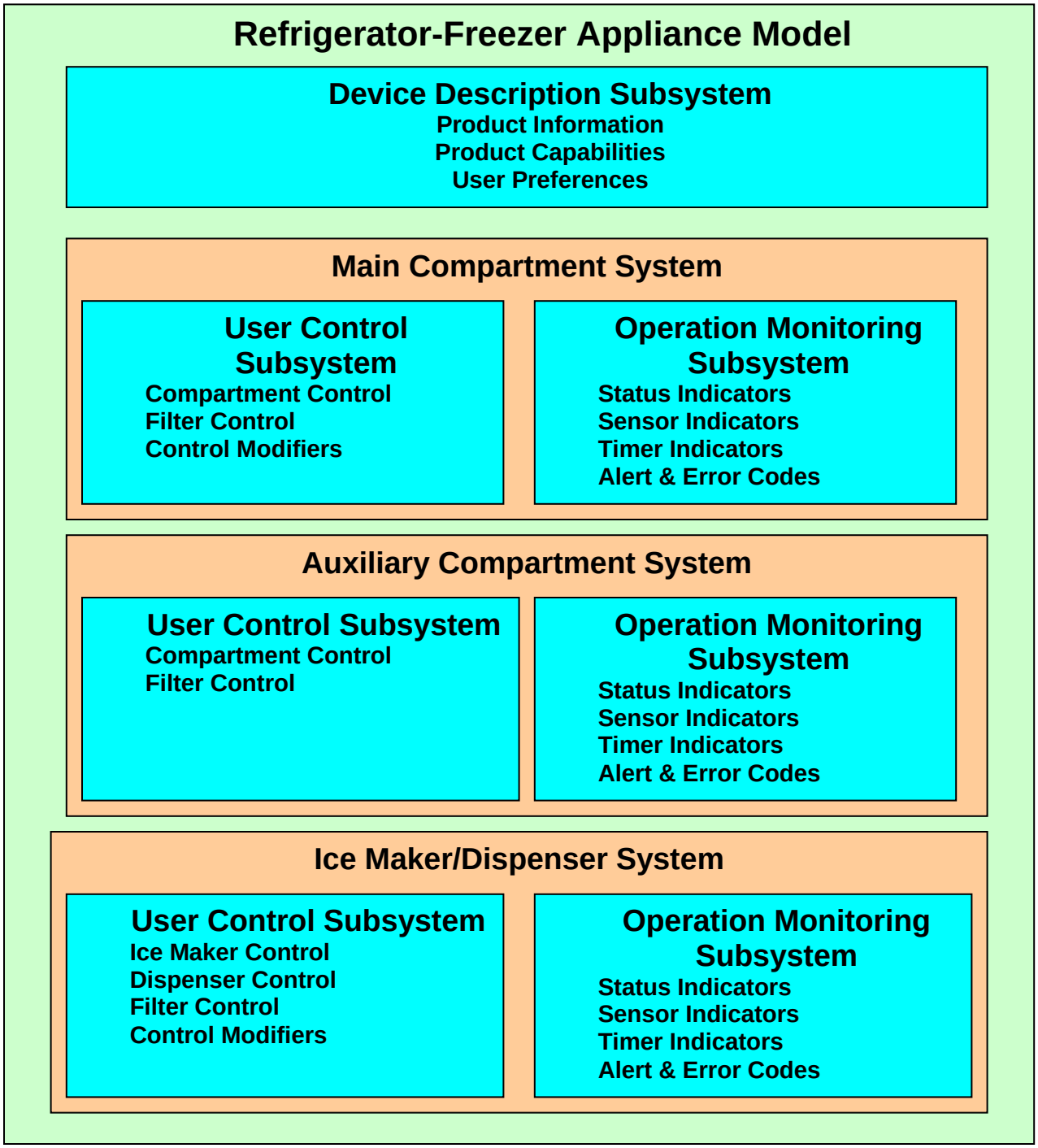

Figure 6.1 – AHAM Appliance Model of Refrigerator-Freezer

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6.1. DEVICE DESCRIPTION SUBSYSTEM (REQUIRED)

The Device Description Subsystem provides information of a general nature about the appliance and a place for objects that are not part of any single system within an appliance.

6.1.1. Product Information Object Container (REQUIRED)

Product information object provides information similar to that found on the nameplate of a physical appliance.

- **Product Information Object (REQUIRED)**

  This object is instantiated from the Device Information Class. The Product Information Object consists of multiple text records. The content of these records is given as follows:

  - AHAM appliance model (refrigerator-freezer): **(REQUIRED)**
  - Nick Name (Get/Set)
    User defined name of appliance (e.g. kitchen fridge)
  - Manufacturer name: **(REQUIRED)**
  - Manufacturer model: **(REQUIRED)**
  - Product serial number
  - Device Online/Offline
    Indicates if device is connected or disconnected from network.
  - Reserved for future Conformance Level definition
    AHAM Specification property identifying appliance capabilities.

6.1.2. Product Capabilities Object Container (REQUIRED)

The AHAM appliance models include required and optional objects and properties. Therefore, there are likely to be many versions of each appliance type (range, dryer, etc.) that conform to the AHAM standard. The purpose of the Product Capabilities Object is to enable an external device to establish effective communications with a target appliance. The Product Capabilities Object lists the specific objects and properties implemented in the target appliance. An external device can read the Product Capabilities Object to discover the features and services supported by that appliance.

- **Product Capabilities Object (REQUIRED)**

  This object is instantiated from the Device Information Class. It contains a list of each object and associated object properties , including any manufacturer specific objects, implemented in the appliance.

  The format of the Product Capabilities Object depends on the specification of the communications protocol with which this appliance model is implemented. A reference implementation of the Product Capabilities Object consists of multiple text records.

  In the reference implementation each text record contains the path to each object implemented and the properties supported by that object. This means that each record should contain the names of the following model elements:

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System (if any), Subsystem, Object Container, Object, and Object Properties supported by that object

Each name should be placed in quotations and comma-delimited, with the exception of the property list, which should be preceded by a semi-colon instead of a comma (to help the parser distinguish between a system name and the first property, since the system level is optional). A colon should terminate each record.

6.1.3. User Preferences Object Container

- **SI Units Mode Object**

This object is instantiated from the Binary Control Class.

  - TRUE = Display temperatures in degrees C
  - FALSE = Display temperatures in degrees F

- **Language Preference Object**

This object is instantiated from the Multifunction Control Class. It is used to select the language used by the appliance. The selections identified for this object are listed below:

  - English
  - French
  - Spanish
  - Etc.
  - None (No selection made)

- **Demo Mode Object**

This object is instantiated from the Binary Control Class. It is used to place the appliance into a demonstration mode typically used for in-store use.

  - TRUE= Demo mode
  - FALSE= Normal operation

- **Service/Diagnostic Mode Object**

This object is instantiated from the Binary Control Class.

  - TRUE= Enable manufacturer-specific service or diagnostic mode algorithm
  - FALSE= Normal operation

- **Sabbath Mode Object**

This object is instantiated from the Binary Control Class. It is used to place the appliance into the Sabbath mode.

  - TRUE= Sabbath mode
  - FALSE= No Sabbath mode

6.2. MAIN COMPARTMENT SYSTEM (REQUIRED)

There shall be one or more main compartments, such as a fresh food compartment, a freezer compartment, or both.

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6.2.1. User Control Subsystem

Front panel functions and other control functions. Unless otherwise noted, all User Control Objects respond to read and write messages, and can issue event messages.

6.2.1.1. Compartment Control Object Container

Settings that control the basic features of the appliance.

- **Temperature Setting Object**

This object is instantiated from the Multifunction Control Class.

- 9/E (coldest) **(REQUIRED)**
- 8
- 7/D **(REQUIRED)**
- 6
- 5/C **(REQUIRED)**
- 4
- 3/B **(REQUIRED)**
- 2
- 1/A **(REQUIRED)**
- Off

- **Precise Temperature Setting Object**

This object is instantiated from the Discrete Control Class. This object can be used in addition to the Temperature Setting object if the refrigerator has the ability to accept actual temperature settings in degrees F or degrees C, vs. the general settings 1 to 9 or A to E used by the multifunction control Temperature Setting object.

- **Door Alarm Enable Object**

This object is instantiated from the Binary Control Class.

- TRUE = Alarm indicates when compartment door open too long
- FALSE = No alarm

6.2.1.2. Filter Control Object Container

- **Reset Freshness Filter Object (Write only)**

This object is instantiated from the Binary Control Class. It is used to reset the freshness filter timer. It is intended to have the same functionality as the front panel button for this purpose. Generally it is activated when a new filter is installed. A read of this object would always return a false.

- TRUE = Reset filter timer
- FALSE = No effect

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