

**Integrating the Healthcare Enterprise**



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# **IHE Patient Care Device Technical Framework Supplement 2008-2009**

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## **Rosetta Terminology Mapping (RTM)**

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## 1 Foreword

Integrating the Healthcare Enterprise (IHE) is an initiative designed to stimulate the integration of the information systems that support modern healthcare institutions. Its fundamental objective is to ensure that in the care of patients all required information for medical decisions is both  
25 correct and available to healthcare professionals. The IHE initiative is both a process and a forum for encouraging integration efforts. It defines a technical framework for the implementation of established messaging standards to achieve specific clinical goals. It includes a rigorous testing process for the implementation of this framework. And it organizes educational sessions and exhibits at major meetings of medical professionals to demonstrate the  
30 benefits of this framework and encourage its adoption by industry and users.

The approach employed in the IHE initiative is not to define new integration standards, but rather to support the use of existing standards, HL7, DICOM, IEEE, IETF, and others, as appropriate in their respective domains in an integrated manner, defining configuration choices when necessary. IHE maintain formal relationships with several standards bodies including HL7,  
35 DICOM and refers recommendations to them when clarifications or extensions to existing standards are necessary.

This initiative has numerous sponsors and supporting organizations in different medical specialty domains and geographical regions. In North America the primary sponsors are the Healthcare Information and Management Systems Society (HIMSS) and the Radiological Society of North  
40 America (RSNA). IHE Canada has also been formed. IHE Europe (IHE-EUR) is supported by a large coalition of organizations including the European Association of Radiology (EAR) and European Congress of Radiologists (ECR), the Coordination Committee of the Radiological and Electromedical Industries (COCIR), Deutsche Röntgengesellschaft (DRG), the EuroPACS Association, Groupement pour la Modernisation du Système d'Information Hospitalier  
45 (GMSIH), Société Française de Radiologie (SFR), Società Italiana di Radiologia Medica (SIRM), the European Institute for health Records (EuroRec), and the European Society of Cardiology (ESC). In Japan IHE-J is sponsored by the Ministry of Economy, Trade, and Industry (METI); the Ministry of Health, Labor, and Welfare; and MEDIS-DC; cooperating organizations include the Japan Industries Association of Radiological Systems (JIRA), the  
50 Japan Association of Healthcare Information Systems Industry (JAHIS), Japan Radiological Society (JRS), Japan Society of Radiological Technology (JSRT), and the Japan Association of Medical Informatics (JAMI). Other organizations representing healthcare professionals are invited to join in the expansion of the IHE process across disciplinary and geographic boundaries.

55 The IHE Technical Frameworks for the various domains (IT Infrastructure, Cardiology, Laboratory, Radiology, Patient Care Devices, etc.) defines specific implementations of established standards to achieve integration goals that promote appropriate sharing of medical information to support optimal patient care. It is expanded annually, after a period of public review, and maintained regularly through the identification and correction of errata. The current  
60 version for these Technical Frameworks may be found at [www.ihe.net/Technical\\_Framework](http://www.ihe.net/Technical_Framework).

The IHE Technical Framework identifies a subset of the functional components of the healthcare enterprise, called IHE Actors, and specifies their interactions in terms of a set of coordinated,

standards-based transactions. It describes this body of transactions in progressively greater depth. The volume I provides a high-level view of IHE functionality, showing the transactions  
65 organized into functional units called Integration Profiles that highlight their capacity to address specific clinical needs. The subsequent volumes provide detailed technical descriptions of each IHE transaction.

**This IHE Patient Care Device (PCD) Technical Framework Supplement is issued for Trial Implementation through May 2009.**

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**Comments and change proposals arising from Trial Implementation may be to: <http://forums.rsna.org> under the “IHE” forum**

**Select the sub-forum**

***“Patient Care Device Supplements 2008-2009 for Trial Implementation”***

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**The IHE Patient Care Device (PCD) Technical Committee will address comments resulting from implementation, Connectathon testing and demonstrations. Final text expected to be published in June 2009, dependant upon results of IHE validation process.**

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## 2 Introduction

110 The primary purpose of the Rosetta Terminology Mapping (RTM) profile is to *harmonize the use of existing ISO/IEEE 11073-10101 nomenclature terms* by systems compliant with IHE PCD profiles. The RTM profile also specifies the correct *units-of-measure* and *enumerated values* permitted for each numeric parameter to facilitate safe and interoperable communication between devices and systems.

115 The Rosetta Table also is designed to serve as a temporary repository that can be used to define *new nomenclature terms* that are currently not present in the ISO/IEEE 11073-10101 nomenclature. Based on our experience to date, well over 100 new terms will be required, principally in the area of ventilator and ventilator settings. This could also serve as a framework for adding and reconciling new terms to support the IEEE 11073 ‘Personal Health Devices’ initiative.

### 2.1.1 Open Issues

120 Open issues that were identified after the Public Comment period closed are listed below.

Open issues that remain from the Public Comment period are documented on the RSNA Forums site at <http://forums.rsna.org/index.php>.

	Open Issue	Status
1	Currently the RTM ‘Vendor_DName’ column may contain a display name (as displayed on a device or flowsheet) or proprietary gateway label. Should this column be split into two columns, e.g. ‘Vendor_DName’ and ‘Vendor_GName’ to clearly distinguish between the two? There was some reluctance to do this during the early development of the RTM.	DEFER
2	Should ‘control’ and ‘alert’ be added to Table 5 ‘Observation Data Types’? Currently, ‘control’ can be deduced from the _SETTING discriminator and ‘alert’ is a subset of ‘evt’ event, so no action need be taken at the present time.	DEFER
3	Certain attributes such as ‘language’ do not have an MDC_ metric identifier. How should these be supported in the HL7 V2 messages? There are two options: 1) define MDC_ identifier for generic status and config info that can go into OBX-3 2) use a status field already present in the OBX (similar to PCD-01 and ACM-01)	BRIEFLY DEFER
4	Add ‘SI’ units to the RTM ‘units’ table? UCUM is the required units-of-measure for HL7 V3, CCD and DICOM, so UCUM has the highest priority as an alternative to ISO/IEEE 11073 units-of-measure. One reviewer brought this up because it is an issue for Canada, which uses SI units.	DEFER
5	Add error codes to the PCD-01 transaction to indicate that a semantic error occurred.	DEFER
6	MDC_ and MDX_ prefix conventions. Several additional suffix conventions were used in the Viasys spreadsheet. Should a separate column be added to the main Rosetta table to indicate the nomenclature status of an MDXxx_ vs. MDC_ terms?	DEFER
7	In the Rosetta Table, full expansion of discriminators is required if the discriminator requires different units-of-measure and/or enumerations for the base term. This will be an issue for the IEEE nomenclature standard, where the units-of-measure may be driven by the discriminator (e.g. -10102 aECG events, event counts, rate of events, etc.) rather than by the base MDC_ term alone.	DEFER IEEE issue

	<b>Open Issue</b>	<b>Status</b>
<b>8</b>	Although the XML file format has not been finalized, it is a relatively straightforward conversion of all the spreadsheet rows to <Row> elements and column headings as children of the <Row> elements. Additional header rows will be added to indicate the version and date.	DEFER
<b>9</b>	Although the RTM and NIST ‘ICSGenerator’ efforts have similar goals regarding rigorous data modeling and validation, the RTM focuses primarily on nomenclature identifiers (including identification of missing terms and definition of new terms) and constraints regarding units-of-measure, enumerations and containment. Is the discussion in §5.9 ‘Rosetta relationship to other tooling’ sufficient to show how the RTM work will integrate with the NIST ICSGenerator or is more detail required?	DISCUSS ~DONE?
-	[Comments highlighted in document body with tan may require further discussion.]	General

125 **2.1.2 Closed Issues**

The majority of issues that have been reviewed and closed are documented on the RSNA Forums site at <http://forums.rsna.org/index.php>.

### 3 Problem Statement

130 The majority of PCD devices use vendor-specific or proprietary nomenclatures and  
terminologies. As a result, even though information may be exchanged using standards-based  
transactions such as Device Enterprise Communication (DEC), semantic interoperability requires  
that the content be mapped to a standard nomenclature as well. This mapping is often  
135 inconsistent and subject to loss of semantic precision when mapping from a specific term to a  
more generic term.

This profile identifies the core set of semantics appropriate for medical devices typically used in  
acute care settings (e.g., physiological monitors, ventilators, infusion pumps, etc.) and mapping  
them to a standard terminology. The RTM mapping effort will initially focus on numeric  
parameters and their associated units of measurement and enumerated values.

140 The RTM information is represented in a uniform manner e.g., in a machine readable form that is  
easily adaptable by industry, initially as a set of Excel worksheets and ultimately as a set of XML  
files for publication and distribution. This will facilitate use by production systems, but more  
importantly, facilitate comparison between vendors that have (or plan to) implement the  
nomenclature standard in their systems, with the following goals:

- 145
- identify terms that are missing from the standard nomenclature
  - ensure correct and consistent use if multiple representations are possible
  - ensure correct and consistent use of units-of-measure
  - ensure correct and consistent use of enumerated values
  - ensure correct and consistent identification of ‘containment hierarchy’

150 During the development of the RTM, gaps in the standardized medical device terminology will  
be identified. In these cases, proposals will be made for adding the semantics to the appropriate  
terminologies. Although the immediate focus of the RTM profile will be to standardize the  
content in transaction profiles such as DEC, which are typically between a device data gateway  
and enterprise level applications, the standardized terms should also support direct device  
155 communication, enabling semantic interoperability literally from the sensor to the EHR.

The availability of the RTM information will also facilitate development of tools that can more  
rigorously validate messages, such as enforcing the use of the correct units-of-measure and  
correct enumerated values associated with specific numeric values. For example, ST segment  
deviation will be expressed in "uV" or "mV", rather than the traditional "mm". This will promote  
160 greater interoperability, clarity and correctness which will in turn benefit patient safety.

The consistent and correct use of a standard nomenclatures such as ISO/IEEE 11073-10101 and  
UCUM for medical device and system data exchange will facilitate further development of real-  
time clinical decision support, smart alarms, safety interlocks, clinical algorithms, data mining  
and other clinical research. This work can be also be expanded at a future date to support events  
165 and alarms, waveforms, device settings and other critical monitoring information.

## 4 Key Use Case

170 A patient is monitored at home. A potentially life-threatening cardiac event is detected and reported to a remote monitoring service that confirms and forwards the event to his caregiver. The patient is subsequently admitted to the ER complaining about chest pain. A diagnostic 12-lead is taken followed by continuous vital signs monitoring or telemetry for further observation. Following a series of premonitory episodes of ST segment deviation, the patient exhibits short runs of ventricular ectopy that rapidly devolve into ventricular tachycardia and then fibrillation. The patient is cardioverted in the ER and scheduled for CABG surgery. During surgery, the patient is connected to well over a dozen medical devices (e.g. multiparameter patient monitor, 175 anesthesia machine, multiple infusion pumps, bypass machine, etc.) and the data from these devices and systems is displayed in a unified and comprehensible manner and automatically charted. After successful surgery, the patient is monitored in the ICU. The patient is discharged a week later to continue his recovery at home, where, among other things, he uses a spirometer with a low-cost wireless interface to facilitate recovery. He also exercises while walking around 180 in and outside the house attached to a wireless sensor that records and transmits his ECG via his cell phone to a remote monitoring service. The patient also has follow-up visits to cardiac rehab, where his ECG and glucose measurements are taken before and after exercise, with all the data also electronically recorded. This information is ultimately stored in the patient's personal health record and made available for a follow-up clinical research study regarding the cardiac 185 medications he was taking.

The key point of this comprehensive but realistic use case is that the patient's data is "touched" by well over three dozen medical devices and systems designed and manufactured by nearly an equal number of different vendors. An essential first step towards achieving interoperability across all these devices and systems is that they use a shared and common semantic foundation.

190 There are two use cases that describe how the RTM can be deployed in an IHE Connectathon for verification and validation of systems that claim compliance to the RTM Supplement. These use cases are described in greater detail in Section 5.8.

## 5 Technical Approach

195 The Rosetta Terminology Mapping uses three tables that define and constrain the semantic content of IHE PCD messages. The three tables are:

Rosetta The Rosetta table contains the observation identifiers, units-of-measure and enumerations that vendors currently support on their gateways and how they plan to map these to the ISO/IEEE 11073-10101 nomenclature and its extensions.

200 Units This table defines all the allowed units-of-measure and normative mapping between the ISO/IEEE 11073-10101 units-of-measure (by Reference IDs and numeric codes) and the equivalent UCUM term(s). It also defines groups of related units-of-measure, such as units used for drug dose, concentration, etc. that are referenced by the primary Rosetta table. It includes additional information required for publication in ISO/IEEE 205 11073-10101 standard so that all of the units-of-measure information can be updated and maintained in a single repository.

Enums This table defines groups of enumerated values (either token strings or as IEEE Reference IDs and numeric codes) that are referenced from the main ‘Rosetta’ table.

210 The tables listed above are developed and maintained as three worksheets within a single Excel spreadsheet. It is anticipated that most of the review, harmonization and identification of missing terms will be done using Excel since all the IHE PCD participants have access to this widely used application.

215 A normative mapping of the Excel worksheets to XML files will be defined. The XML format will be used for publication and distribution of the Rosetta Table as a standard since it can be embedded in the traditional ‘printed’ standards format used by ISO and IEEE. The XML format will also be used to facilitate final review and cross-checking of the observation identifiers, units-of-measure and enumerations as well as the creation of the final set of terms that will be used for verification and validation.

220 The immediate objective of the RTM project is to specify a standards-based nomenclature that is sufficiently complete and comprehensive to replace the non-standard nomenclatures currently used by contemporary gateways for exporting real-time vitals signs information. The subsidiary objectives are listed in order of importance below:

- 225
1. Identify observation identifiers, units-of-measure and enumerations that are missing from the standard nomenclature and facilitate their creation and definition.
  2. Harmonize the use of observation identifiers if multiple interpretations are possible.
  3. Ensure correct and consistent use of ISO/IEEE 11073 and UCUM units-of-measure.
  4. Ensure correct and consistent use of enumerated values relative to each identifier.
  5. Identify ‘containment hierarchy’ relative to each observation identifier.

230 The structure and content of the RTM tables is defined in the sections that follow.

## 5.1 Rosetta Terminology Mapping Table

Vendors, typically participating as a IHE PCD Device Observation Reporters, will contribute a table listing the numeric parameters they plan to support. Each row of the table submitted by each vendor is principally identified by its ISO/IEEE 11073-10101 ‘Reference ID’ (REF\_ID) that the vendor believes is an appropriate match to their existing terminology. In addition to the REF\_ID, the ISO/IEEE 11073 or UCUM units-of-measure and other information listed under ‘Column Name’ in Table 1 are provided by the vendor.

**Table 1: Main Rosetta Table Contents (Rosetta Worksheet)**

Column Name	Description	Status	value
Group	Parameter and/or other group identifier (see Parameter Group Table in §5.4)	R	t+
REF_ID	IEEE Reference ID e.g. MDC_ECG_HEART_RATE	C	t+
PART	Code partition (decimal)	C	#+
CODE10	Context-sensitive code (decimal)	C	#+
CF_CODE10	Context-free code (decimal, <i>calculated</i> from PART and CODE10)	X	#+
Vendor_ID	Vendor identifier (see Vendor Identifier Table in §5.5)	M	str
Vendor_Description	Vendor description of parameter	M	str
Vendor_DName	Vendor Displayed Name	M	str
Vendor_UOM	Vendor UOM	C	t*
UOM_UCUM	UCUM units-of-measure: list of (individual tokens and/or _uom groups)	C	(ut _ut)*
UOM_IEEE	IEEE units-of-measure: <i>list of</i> (individual tokens and/or _uom groups)	C	(ut _ut)*
UPART	IEEE Unit Code partition (decimal)	O	depr
UCODE10	IEEE Units context-sensitive code (decimal)	O	depr
CF_UCODE10	IEEE Units context-free code (decimal, calculated from UPART and UCODE10)	O	depr
Vendor_Status	Vendor implementation status: { GDN   GDF   DN   DF } (see Table 2 in §5.1.1)	M	t
Vendor_Sort	Vendor numeric index for sorting (to restore original vendor row order)	R	####
Enum_Values	Enumerated values: <i>list of</i> (individual tokens and/or _enum groups)	C	(et _et)*
External_Sites	External OBX-20 Site identifiers: <i>list of</i> (individual tokens and/or _enum groups)	C	(et _et)*
DataType	Physiologic data type (num, wav, evt, etc.) (see Table 3 in §5.1.2)	M	t+
ContainedBy	Lists containment identifiers that this term is a “child-of” (see §5.1.3)	C	(et _et)*
Contains	Lists terms or _groups of terms that this term is a “parent-of” (see §5.1.3)	C	(t _t)*
Rank	Rank value (typically used to assess probability of valid term)	X	# *
Vendor_Discussion	Vendor discussion area to support term harmonization.	O	str ?
General_Discussion	General discussion area to support term harmonization	O	str ?

240

### Table 1 Notes (normative, general):

1. **Status** (*re vendor provided information*): **M** Mandatory **R** Recommended **C** Conditional **O** Optional **X** No Entry (this value is calculated)

- 245 2. *value* column: ‘**str**’ string with blanks ‘**t**’ token ‘**#+**’ decimal digits ‘**####**’ four decimal digits (for sorting)  
 ‘**ut**’ ‘unit token’ ‘**\_ut**’ ptr to group of unit tokens (on **\_UOM\_GROUP** worksheet)  
 ‘**et**’ ‘enum token’ ‘**\_et**’ ptr to group of enum tokens (on **\_ENUM\_GROUP** worksheet)  
 ‘**t**’ token ‘**\_t**’ ptr to group of tokens on main worksheet  
 ‘?’ zero-or-one ‘\*’ zero-or-more ‘+’ one-or-more ‘|’ or (choice of)  
 ‘**depr**’ UPART, UCODE10 and CF\_UCODE10 columns will be deprecated
- 250 3. Comma (,) and <> are not permitted in table for facilitate export to .csv and xml formats.  
 Use wavy braces { } instead of <> to indicate ‘channelized’ quantities instead.
4. Strings containing multiple tokens and/or \_pointers are whitespace separated.

**Table 1 Notes (normative, row-specific):**

- 255 5. It is **strongly recommended** that the vendor categorize their term using one of the groups in the ‘Group’ Table.  
 This will facilitate review and comparison, especially for new terms that do not have an MDC\_ prefix.
- 260 6. To represent *existing* MDC\_ and *proposed* MDX\_ terms, the following conventions are used:  
 a) **Existing observation identifiers** that are *defined* in any of the ISO/IEEE 11073 nomenclatures shall have a REF\_ID that starts with the ‘MDC\_’ prefix and shall have a PART and CODE10 value, if already assigned.  
 b) **Proposed observation identifiers** shall start with the ‘MDX\_’ prefix.  
 c) If there is any uncertainty regarding the use of an existing ‘MDC\_’ term, a question mark ‘?’ shall be appended to the end of the REF\_ID string.
7. *At least one* UOM\_UCUM **or** UOM\_IEEE *shall* be provided for numeric observations (both *may* be provided).  
 Multiple units-of-measure of either type *may* be listed if supported by a vendor’s gateway and/or device. Use the MDX\_ prefix for proposed new units-of-measure (this should be very rare).
- 265 8. The UPART, UCODE10 and CF\_UCODE10 columns will be deprecated in the future since this information will be maintained *solely* on the **\_UOM\_GROUPS** worksheet. These columns will be retained on the main worksheet until they can be verified against the units worksheet.
9. Enumerated values and/or external measurement sites shall be provided if they are used.

**5.1.1 Vendor Implementation Status**

270 Vendor Implementation Status enumerations are listed in Table 2 below. The Vendor\_Status enumerations can be sorted, with the lexically higher values indicating the highest priority need for a standardized nomenclature term, i.e. ‘GDN’ represent terms that are *currently implemented* in the vendor’s gateway and devices and clearly require a standardized identifier.

**Table 2: Vendor Implementation Status**

Vendor_Status	Description
GDN	Gateway and Device Now: currently implemented in gateway and device using legacy nomenclature.
GDF	Gateway and Device Future: proposed new term for vendor’s gateway and possibly device.
DN	Device Now: currently implemented on device but no immediate need for implementation on gateway (e.g. real-time device control, etc.).
DF	Device Future: proposed new term for device but no immediate need for implementation on gateway (e.g. real-time device control, etc.)

## 5.1.2 Observation Data Types

275 The observation data type enumerations are listed in Table 3 below.

**Table 3: Observation Data Types**

DataType	Description
obs	<b>a numeric or enumerated observation or measurement, including the subtypes:</b> - <b>numeric value, periodically reported</b> (e.g. heart rate) - <b>numeric value, episodically reported</b> (e.g. an NIBP measurement) - <b>enumerated value, periodically reported</b> - <b>enumerated value, episodically reported</b>
evt	<b>an event identifier, typically an IEEE “pattern” event like “asystole”</b> - a <b>“time-point” pattern event, indicated by a momentary “tpoint” transition</b> - an <b>“interval event” pattern event, delineated by a start and end transition</b> - <b>numeric alarm limits are “interval events” identified by the numeric parameter</b> - <b>alarms fall in the “evt” category and thus may be filtered (removed)</b>
btb	<b>a beat-by-beat or breath-by-breath annotation</b> - <b>typically does not convey alarm information</b> - <b>this is typically not a filtered stream, so missing “btb” events represent missed events</b>
wav	<b>a waveform identifier</b>
wrapper	<b>An “Implanted Device Cardiac” (IDC) wrapper term for “leaf” observations</b> - <b>used in a two-level observation identifier hierarchy</b>

**Table 3 Notes (normative):**

1. A ‘periodic’ versus ‘episodic’ observation is based on messaging context.
- 280 2. A ‘numeric’ versus ‘enumerated’ observation is based on the existence of one or more entries in the ‘Enum\_Value’ and/or ‘External\_Sites’ columns.
3. A ‘setting’ value is indicated by the presence of the \_SETTING discriminator in the REF\_ID.

**Table 3 Notes (informative):**

- 285 i. Although the majority of ISO/IEEE 11073-10101 numeric observation identifiers use the { \_MIN, \_MAX, \_AVG } discriminator and are all of the same ‘type’, that is not necessarily true of other partitions and code blocks such as the proposed -10102 “Annotated ECG” nomenclature extension where the discriminator can reclassify the base term as a time-point or interval event, count of events, rate of events, etc. In this case, the REF\_ID listed in the ‘primary’ Rosetta Table must include the discriminator to ensure unambiguous matching with the Observation Data Type.
- 290 ii. The -10103 IDCO terminology project strongly favors a two-level hierarchy consisting of a top-level ‘wrapper’ containing one or more ‘leaf’ observations, rather than the four level ‘dotted’ hierarchy used in the IHE PCD technical profile.

### 5.1.3 Containment Hierarchy: ‘ContainedBy’ and ‘Contains’

295 An observation identifier may indicate that it is the leaf <metric> node that belongs to one or more <mds>/<vmd>/<chan>/<metric> hierarchies expressed in the ‘ContainedBy’ column.

The ‘ContainedBy’ column contains zero or more whitespace-separated triplets of the <mds>/<vmd>/<chan> heirarchy that is the parent of the <metric> identifier. A slash ‘/’ separator is used to separate the three components <mds>/<vmd>/<chan> that comprise the triplet, with no intervening whitespace within the triplet.

300 The containment information is often optional for many PCD-01 messages since the <metric> identifier is often a stand-alone term (e.g. ‘MDC\_ECG\_HEART\_RATE’). To support this, the ‘ContainedBy’ column allows a ‘default’ containment tree to be specified where it is safe and sensible to do so, especially when the <metric> identifier is largely a context-free stand-alone term. This is specified in the Rosetta ‘ContainedBy’ column by enclosing any or all of the  
 305 <mds>, <vmd> and <chan> terms with a pair of square braces ‘[’ and ‘]’. In the HL7 V2 message, the ‘default’ OBX’s can be omitted and the default value shall be assumed. Any ‘containment’ <mds>, <vmd> and/or <chan> OBX’s that are present in the HL7 V2 message override the default value specified by the Rosetta table.

The use of the ‘ContainedBy’ value is illustrated by the following examples:

- 310 1. All three <mds>, <vmd> and <chan> containment OBX’s are optional:  
 [MDC\_DEV\_ANALY\_SAT\_O2\_SYS]/[MDC\_DEV\_ANALY\_SAT\_O2\_VMD]/[MDC\_DEV\_ANALY\_SAT\_O2\_CHAN]
2. All three <mds>, <vmd> and <chan> containment OBX’s are required:  
 MDC\_DEV\_ANALY\_SAT\_O2\_SYS/MDC\_DEV\_ANALY\_SAT\_O2\_VMD/MDC\_DEV\_ANALY\_SAT\_O2\_CHAN
- 315 3. An infusion pump with a “primary” and “secondary” channel *both* report the <metric> MDC\_FLOW\_FLUID\_PUMP, so the <chan> containment OBX is required to define the ‘primary’ and ‘secondary’ channels as a whitespace separated pair of <mds>/<vmd>/<chan> triplets:  
 [MDC\_DEV\_PUMP\_INFUS\_MDS]/[MDC\_DEV\_PUMP\_INFUS\_VMD]/MDC\_DEV\_PUMP\_INFUS\_CHAN\_SOURCE  
 [MDC\_DEV\_PUMP\_INFUS\_MDS]/[MDC\_DEV\_PUMP\_INFUS\_VMD]/MDC\_DEV\_PUMP\_INFUS\_CHAN\_DELIVERY
- 320 4. The Implanted Devices Cardiac (IDCO) terminology currently uses a two-level hierarchy, so only a single required or [optional] MDC\_ ‘wrapper’ term should be listed for the <metric> MDC\_IDC\_SHOCK\_ENERGY within the complex metric ‘wrapper’ identified by the ‘ContainedBy’ value MDC\_IDC\_TACHY\_ZONE\_SETTING.

325 The ‘Contains’ column provides an alternative representation for the two-level IDCO hierarchy, where the IDCO ‘wrapper’ terms specify the ‘leaf’ <metric> observation identifiers as a whitespace-separated list of individual or group identifiers (the latter identified by the ‘Group’ column of the Rosetta Table). In this representation, the ‘Contains’ column provides an alternative ‘parent-of’ representation relative to the ‘leaf’ <metric> observation identifiers.

## 5.2 Units-of-Measure Table

330 The RTM ‘Units-of-Measure’ Table defines all allowed units-of-measure and mapping between UOM\_IEEE and UCODE10 and the equivalent UOM\_UCUM term(s). It also includes all other information required for publication in the ISO/IEEE 11073-10101 standard.

**Table 4: Units-of-Measure Table Contents ( Units Worksheet )**

Column Name	Description	value
Dimension	<b>Dimension, e.g.</b> “L <sup>3</sup> T <sup>-1</sup> (volume flow rate)”	<b>str?</b>
Unit_of_Measure	<b>Brief description, e.g.</b> “cubic «magnitude» meter(s) per second”	<b>str?</b>
Symbol	<b>Common printed format with superscripting (e.g. m<sup>3</sup> s<sup>-1</sup>)</b>	<b>str?</b>
UOM_UCUM	<b>UCUM representation(s), preferred listed first (e.g. m<sup>3</sup>/s)</b>	ut+
UOM_IEEE	<b>IEEE UOM Reference ID (e.g. MDC_DIM_CUBIC_X_M_PER_SEC)</b>	ut
UCODE10	<b>UOM context sensitive code, decimal number (e.g. 2912)</b>	#+
_UOM_GROUPS	<b>UOM group identifier(s), prefixed by an underscore ‘_’.</b>	<b>_ut *</b>
Discussion	<b>Discussion to support term harmonization.</b>	<b>str?</b>

335 **Table 4 ‘Units’ Notes (normative):**

1. This table uses Unicode (Arial Unicode MS) to support superscripts in spreadsheet and XML file.
2. Chevrons «magnitude» replace <magnitude> from ISO/IEEE 11073-10101. Commas are not permitted.
3. The ‘base’ UOM\_IEEE unit-of-measure identifier listed in the Excel or XML units-of-measurement table *shall* use the ‘\_X\_’ convention (e.g. MDC\_DIM\_CUBIC\_X\_M\_PER\_SEC) to indicate *where* the decades scale factor should go. This preserves the current ISO/IEEE 11073-10101 units-of-measure convention, including the interpretation that ‘\_X\_’ implies *unity scaling*, and that the Description, Symbol, UOM\_UCUM and UCODE\_10 values *in the same row* also correspond to *unity scaling*.
- 340 4. In contrast, the main page of the RTM table and messages that use the RTM *shall* omit the ‘\_X\_’ subtoken and replace it with a *single* ‘\_’ to indicate a unit-of-measure with unity scaling. Prior to use, the RTM processing application shall internally replace the ‘\_X\_’ subtoken in the run-time copy of the units table with a single underscore ‘\_’ for string comparison.
- 345 5. UOM\_IEEE and UOM\_UCUM units-of-measure that have a scale factor *other than* unity (10<sup>0</sup>) shall be listed in their own rows, immediately following the unity-scaled ‘base’ representation. The UOM\_UCUM, UOM\_IEEE and UCODE\_10 values shall be listed in these rows and all other cells in these rows should be left empty.
- 350 6. Multiple *equivalent* UOM\_UCUM tokens may be listed, with the preferred listed first, e.g. the ‘beats per minute’ units for heart rate would be the whitespace separated list “**1/min {beat}/min {beats}/min {h'b}/min**”.
7. A corollary to (5) and (6) is that every unit-of-measure row shall have a single ‘UOM\_IEEE Reference ID, a single UCODE10 and one or more UCUM tokens in the UOM\_UCUM column, except in the extremely rare case where UOM\_IEEE or UOM\_UCUM cannot express the *identically equivalent* unit-of-measure.

355 **Table 4 ‘Units’ Notes (informative):**

- 360 i. In ISO/IEEE 11073-10101 standard, the descriptive ‘Dimension’ information, e.g. ‘L<sup>3</sup>T<sup>-1</sup> (volume flow rate)’, *may* be printed as a separate ‘topic row’ followed by one or more rows containing the specific IEEE and UCUM units-of-measure *or* it may be included in the same row that contains the specific IEEE and UCUM information, especially if the latter is a single row. This convention is maintained in the Excel spreadsheet for readability and compactness.
- 365 ii. Although the majority of ISO/IEEE 11073-10101 numeric observation identifiers use the { `_MIN`, `_MAX`, `_AVG` } discriminator and have the same units-of-measure, that is not necessarily true of other partitions and code blocks where the discriminator modifies the units-of-measure. For example, the -10102 “Annotated ECG” (aECG) nomenclature extension can reclassify the base term as an event, count of events, rate of events, etc. In this case, the REF\_ID listed in the ‘primary’ Rosetta Table must include the discriminator to ensure unambiguous matching with the units-of-measure.
- 370 iii. There are several consistency checks that could potentially be applied as general rules on the units-of-measure table. First, the UOM\_IEEE ‘\_X\_’ scale factor in the REF\_ID can be automatically against the numeric code offset. Second, certain discriminators that indicate a ‘rate per unit time of an event’ should have a ‘1/time’ unit, a ‘count of events’ should have a ‘unitless’ unit, etc. Similar rules could be applied against UOM\_UCUM units.
- iv. The use of `_UOM` groups should be minimized for groups with less than five UOM terms; they should be listed on the main Rosetta table instead.

### 5.3 Enumerated Values Table

375 The RTM ‘Enumerated Values’ Table defines groups of enumerated values that can be referenced by one or more observation identifiers listed in the ‘main’ Rosetta Table.

**Table 5: Enumerated Values Table Contents ( Enum Worksheet )**

Column Name	Description	value
_ENUM_GROUPS	Enumeration group identifier, prefixed by an underscore ‘_’. This is typically the REF_ID of the observation identifier, prefaced by an underscore ‘_’.	_et +
Vendor_Description	Short vendor description of enumeration group.	str ?
ENUM_VALUE_CODE	Enumerated value token, or, alternatively	t ?
ENUM_VALUE_REF_ID	IEEE enumerated value code (e.g. alarm identifiers)	t ?
EPART	. Enum partition, e.g. 1, 2, ... (decimal)	# *
ECODE10	. Enum context sensitive code (decimal)	# *
CF_ECODE10	. Enum context free code (decimal, calculated from EPART and ECODE10)	# *
Vendor_Enum_Description	Vendor description this specific enumerated value	str ?
Discussion	Discussion to support term harmonization.	str ?

**Table 5 Notes (normative):**

- 380 1. Enumerations may either be an
- 1A: ‘ENUM\_VALUE\_CODE’ that are descriptive tokens corresponding to IEEE 11073 bit flags, *or*
  - 1B: ‘ENUM\_VALUE\_REF\_ID’ that are MDC\_ nomenclature terms (e.g. alarms). In this case, the EPART and ECODE10 must be specified, and the CF\_ECODE10 is calculated.

**Table 5 Notes (informative):**

- 385 i. If necessary, vendor columns indicating the Vendor\_ID and vendor implementation status for enumerated values could be added if this degree of specificity is required.

## 5.4 Parameter Group Table

390 The RTM ‘Parameter Group’ Table defines the set of ‘Group’ identifiers that are used to group like-kind observation identifiers. They are hierarchically structured by *organ or body system* and then by physiologic signals typically acquired by devices, e.g. CNS\_EEG. Group identifiers may be referenced by one or more observation identifiers listed in the ‘main’ Rosetta Table. The ‘Parameter Group’ Table is defined as a separate worksheet (rather than in this Supplement) since it is likely to be revised. The ‘Group’ identifiers are the only normative content of this table; the ‘System’, ‘Signal-Device’ and ‘Description’ are informative.

395

**Table 6: Parameter Group Table Contents ( Group Worksheet )**

Column Name	Description	value
System	Principal physiologic system (or device subsystem)	str ?
Group	Hierarchically structured terminology Group identifier.	token
Signal-Device	Common displayed signal or physiologic parameter name.	str
Description	Short description	

Representative values from the ‘Group’ table for the Central Nervous System are shown below:

400

System	Group	Signal-Device	Description
CNS (Brain)	CNS_EEG	eeg	electroencephalogram and ‘computed EEG’ parameters
	CNS_EEG_BIS	eeg-bis	electroencephalogram - bispectral index
	CNS_EEG_ENTROPY	eeg-entropy	electroencephalogram - entropy
	CNS_EP	ep	evoked potential
	CNS_EOG	eog	electroculogram
	CNS_EMG	emg	electromyogram
	CNS_NMT	nmt	neuromuscular transmission
	CNS_EVAL	{clinician observation}	semi-quantitative neurological evaluations
	CNS_PRESS_CEREB_CPP	cpp	cerebral perfusion pressure
	CNS_PRESS_CRAN_ICP	icp	intracranial pressure

### Notes (informative)

- 405
- i. The <Group> classification facilitates gathering of ‘like-kind’ nomenclature terms for the following purposes:
    - a) to *display* numeric parameters by *top-level organ or body system*;
    - b) to *review closely related terms* for harmonization, e.g. minimize differences in how data is identified;
    - c) to *identify missing terms or concepts* so that they can be added to the existing ISO/IEEE 11073 nomenclatures;
    - d) to *facilitate queries* by organ or body system.

## 5.5 Vendor Identifier Table

410 The RTM ‘Vendor Identifier’ Table lists the ‘Vendor\_ID’ values that are used to identify vendor rows (contributions) in the main Rosetta Table. It is defined as a separate worksheet (rather than in this document) since new vendors are likely to be added in the future

**Table 7: Vendor Identifiers and Suffixes ( Vendor Worksheet )**

Column Name	Description	value
<b>Vendor_ID</b>	Vendor or Organization Identifier	token
<b>Suffix</b>	Suffix	token
<b>Vendor_Name</b>	Complete vendor or organization name	str

415 A suffix identifier may also be defined to indicate a vendor-specific group identifier. For example, the Hospira specific version of the ‘\_DRUG\_DOSE\_RATE’ enumeration group would be ‘\_DRUG\_DOSE\_RATE\_HSP’. At the time of this writing (August 2008), the following vendors had contributed to the RTM project:

Vendor_ID	Suffix	Vendor_Name
IEEE	<b>IEEE</b>	<b>ISO/IEEE 11073-10101 and its extensions</b>
Draeger		<b>Draeger Medical</b>
GE_Aware	<b>GE</b>	<b>GE (Aware Gateway)</b>
Philips		<b>Philips Healthcare</b>
WelchAllyn		<b>Welch Allyn</b>
LiveData		<b>LiveData</b>
BBraun_PL		<b>BBraun and ProtoLink</b>
Spacelabs		<b>Spacelabs Healthcare</b>
EPIC	<b>EPIC</b>	<b>EPIC</b>
Capsule		<b>Capsule Technologie</b>
VIASYS		<b>Cardinal VIASYS</b>
Hospira	<b>HSP</b>	<b>Hospira</b>

## 5.6 Rosetta Harmonization Goals

420 The next phase of the RTM effort is to discuss, refine and harmonize the observation identifiers, units-of-measure and enumerations. This will be an interactive process using the worksheets for initial discussion and analysis followed by more rigorous cross-checking using the XML files.

The process of nomenclature harmonization will involve the following steps:

### 5.6.1 Identify and resolve implementation differences

425 The tables submitted by the individual vendors will be merged into a single Excel spreadsheet to facilitate discussion.

The information initially submitted as an Excel spreadsheet will also be converted into an XML document. This will facilitate the use of tools such as XSLT to find differences. For example, XSLT can be used to create a list of the MDC reference identifiers and the vendors that selected it, and MDC identifiers that were selected by only a single vendor would be examined and compared with similar terms.

### 5.6.2 Identify missing terms and propose new terms

435 It is likely that new terms will need to be added to represent new concepts and terms since the publication of the ISO/IEEE 11073-10101 nomenclature standard. Any missing or new MDC reference identifiers will be submitted to the appropriate standards group (typically IEEE 11073 and its working groups) to create and add the new terms to the relevant standard.

### 5.6.3 Generate final set of terms, units-of-measure and enumerations

440 Any corrections or additions will be reflected back the vendor's table and a new version of the merged table (and XML files) will be created. This review-edit-merge cycle will be performed several times until there is general agreement by the participants that the Rosetta Table provides (1) an accurate mapping of their device data to a standard terminology while (2) minimizing the 'bleed through' of vendor-specific terminology as much as possible.

445 At this point, a 'harmonized' version of the Rosetta Table is generated from the original Rosetta Table using XSLT. The vendor-neutral 'harmonized' table will be used for subsequent verification at the Connectathon, while the vendor-specific content of the original Rosetta Table can be used for validation where access to vendor display identifiers is required.

## 5.7 Harmonized Rosetta Table

450 The ‘harmonized’ Rosetta Table is automatically generated from the original Rosetta, Units and Enums tables using XSLT or other transform language. Each row in the harmonized table represents a single ISO/IEEE 11073-10101 nomenclature identifier (and its extensions) as specified by the single { PART, CODE10 and calculated CF\_CODE10 } value. Multiple REF\_IDs may be specified since synonym REF\_IDs are permitted by ISO/IEEE 11073-10101, but the preferred REF\_ID should be listed first.

455 The values for all other rows in the harmonized table include one or more terms that represent the (distinct) union of all the terms that are present in the original Rosetta Table after the iterative review process has been completed and general consensus appears to have been achieved.

**Table 8: Harmonized Rosetta Table Contents (automatically generated)**

Column Name	Description	Status	Value
Group	Parameter and/or other group identifier (see Parameter Group Table in §5.4)	R	1..*
REF_ID	IEEE Reference ID e.g. MDC_ECG_HEART_RATE (synonyms permitted)	M	1..*
PART	Code partition (decimal)	M	1..1
CODE10	Context-sensitive code (decimal)	M	1..1
CF_CODE10	Context-free code (decimal, <i>calculated</i> from PART and CODE10)	M	1..1
UOM_UCUM	UCUM units-of-measure	C	1..*
UOM_IEEE	IEEE units-of-measure	C	1..*
Enum_Values	Enumerated values	C	1..*
External_Sites	External OBX-20 Site identifiers	C	1..*
DataType	Physiologic data type (num, wav, evt, etc.) (see Table 3 in §5.1.2)	M	1..*
ContainedBy	Lists VMD or VMD/channel identifiers that this term is a “child-of” (see §5.1.3)	C	1..*
Contains	Lists terms or _groups of terms that this term is a “parent-of” (see §5.1.3)	C	1..*

460 **Table 8 Notes (normative):**

1. For simplicity, references to \_group pointers have been removed and only lists of individual terms are provided.
2. Multiple REF\_IDs are permitted to support exact synonyms, with the preferred REF\_ID listed first.
3. **Status:** *Value strings are:* **M** Mandatory **R** Recommended **C** Conditional
4. **Conditional status** detail:
  - 465 a) UOM\_UCUM and UOM\_IEEE are required for observations reporting a numeric value, e.g. heart rate.
  - b) Enum\_Values are required if the observation reports enumerated values, e.g. operational mode.
  - c) External\_Sites are required if the observation reports external measurement sites, e.g. EEG electrode sites.
  - d) ContainedBy string(s) may include [default] values for any or all of the <mds>, <vmd> and/or <chan> OBXs.

## 470 **5.8 Rosetta Deployment, Verification and Validation**

The ‘harmonized’ Rosetta Table provides the observation identifiers, units-of-measure, enumerated values and other information to support rigorous verification of message semantic content. There are at least two basic use cases that could be supported by the RTM:

- 475 1. Embed RTM verification in a ‘third-party’ observer that snoops PCD-01 network traffic.
2. Embed RTM verification in a PCD-01 compliant receiving and/or transmitting gateway.

No additional transactions need to be defined; existing transactions can be used with the possible addition of new error codes to indicate semantic verification errors. [define and add to PCD-01?]

480 RTM verification can be triggered whenever an observation identifier is recognized in the message, based on the:

- four-level hierarchy used by PCD-01 and related messages,
- five-level hierarchy used by ACM-01 and related messages [future],
- two-level hierarchy proposed for IDCO messages [to be finalized by IDCO group],

485 The observation identifier serves as a lookup key to the units-of-measure, enumerations and other information in the ‘harmonized’ Rosetta Table. These values are compared with the corresponding values in the incoming message and an error is reported if the incoming values do not match any of the values permitted for the particular observation identifier, assuming that the identifier itself is valid.

## 490 **5.9 Rosetta relationship to other tooling (NIST ICSGenerator)**

The National Institute of Standards and Testing (NIST) is currently developing the ‘ICSGenerator’ and related tools that can be used to validate PCD-01 HL7 V2 messages. It is desirable that either effort (RTM or ICSGenerator) can leverage the work of the other.

495 One very feasible starting point is to have the ICSGenerator create a flattened table identical to the “Harmonized Rosetta Table” described in §5.7 . This will facilitate comparison between the two representations, such as detecting extra or missing terms and constraints in each. Eventually more sophisticated integration could occur, but this would be a good starting point.

500 Parenthetically, the RTM is excellently suited for capturing vendor requirements for a standardized nomenclature and verifying that it meets their needs (i.e. that vendors can map all their legacy identifiers, units-of-measure, enumerations and other information to the standard representation). The RTM can be supplemented by other tools that facilitate the design of a hierarchically structured nomenclature.

## 6 Relationship to existing IHE PCD Technical Profiles

### 505 6.1 Existing Actors

**Device Observation Reporter** - The Device Observation Reporter (DOR) actor receives data from patient care devices (PCDs), including those based on proprietary formats, and maps the data to messages that provide consistent syntax and semantics before sending them to the Device Observation Consumer (DOC) or Device Observation Filter (DOF).

510 **Device Observation Consumer** - The Device Observation Consumer (DOC) actor is responsible for receiving PCD data from the Device Observation Reporter, the Device Observation Filter, or both.

**Device Observation Filter** - The Device Observation Filter (DOF) actor is responsible for providing PCD data filtering services based on the publish/subscribe predicates negotiated with the client DOC application.

515

### 6.2 New actors

None.

### 6.3 Existing transactions

520 **Communicate PCD Data (PCD-01)** Transmit PCD data to enterprise clients from a Device Observation Reporter (or Observation Filter for PCD-02) and Receive PCD data by a Device Observation Consumer.

**Subscribe to PCD Data (PCD-02/SPD)** Defines predicate(s) for communication of PCD data from a DOF to a Device Observation Consumer.

525 The number of numeric parameters supported by the DOR, DOC and DOF transactions will be increased but the transaction syntax and messaging will not be affected by this profile proposal.

### 6.4 New transactions (standards used)

None.

### 6.5 Impact on existing integration profiles

530 None, other than that the number of numeric parameters supported by the DOR, DOC and DOF transactions will be increased, but the existing transaction syntax and sequencing will not be affected by this profile proposal.

### 6.6 New integration profiles needed

None.

## 7 Breakdown of tasks that need to be accomplished

535 The tasks described in Section 5 are summarized below:

- Create a uniform tabular representation (Excel spreadsheet and XML files) that will facilitate comparison and discussion.
- Identify minor implementation differences and resolve them.
- Identify missing terms and propose terms that should be added to existing standard terminologies.

540

- Generate final set of terms, units-of-measure and enumerations for verification and validation.

## 8 Glossary

545 **RTM** – Rosetta Terminology Mapping

**DEC** – Device Enterprise Communication (Profile)

## 9 References

- «**IEEEandUCUM.2e.doc**» dated 2008-01-31T14
- 550 Defines the mapping between ISO/IEEE 11073-10101 and UCUM Units-of-Measure, technical note by Paul Schluter.
- [**UCUM**] The ‘Unified Code for Units of Measure’ (UCUM), <http://aurora.regenstrief.org/UCUM>.
- 555 An on-line UCUM units conversion calculator is available at <http://aurora.regenstrief.org/~shadow/units/>.
- [**ISO/IEEE 11073-10101**] *Health informatics — Point-of-care medical device communication — Part 10101: Nomenclature*, First edition, 2004-12-15. ISO and IEEE, 2004.
- 560 [**IEEE 11073**] *Health informatics — Point-of-care medical device communication — ...*, a general reference to standards within the IEEE ‘Medical Device Communications’ family of standards.
- [**LOINC**] Logical Observation Identifiers Names and Codes, <http://www.regenstrief.org/medinformatics/loinc/>
- [**IHE PCD RTM Wiki**] [http://wiki.ihe.net/index.php?title=PCD\\_Profile\\_Rosetta\\_Terminology\\_Mapping](http://wiki.ihe.net/index.php?title=PCD_Profile_Rosetta_Terminology_Mapping)
- 565 *The Wiki site has a link to the files and documentation shown at HIMSS 2008:*
- |  |   |
|--|---|
| « <b>RosettaTable.1k.doc</b> »                             | Overall description.  |
| « <b>RosettaTable.1k.2008-02-14T14.xls</b> »               | Excel spreadsheet listing vendor numeric mapping information. |
| « <b>RosettaTable.1k.2008-02-14T14.xml</b> »               | XML representation of spreadsheet.                            |
| « <b>tableOutput.1k.allGroups.vendor.dname.xsl</b> »       | XSLT to create consolidated vendor html table.                |
| 570 « <b>RosettaTable.1k.2008-02-14T14.html</b> »          | Summary table with consolidated vendor mapping information.   |
| « <b>Rosetta.1k.2008-02-12T15.groups.2cols.FINAL.doc</b> » | Two-column format used for HIMSS IHE Showcase wall.           |
| « <b>Rosetta.1k.2008-02-12T15.groups.1col.FINAL.doc</b> »  | Alternative single column format.                             |
- [An updated version ‘2a’ of the Rosetta Table is currently under development and review]