Integrating the Healthcare Enterprise

IHE Devices (DEV) Technical Framework

Volume 3
IHE DEV TF-3
Semantic Content

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CONTENTS

1 Introduction

This document, Volume 3 of the IHE Devices (DEV) Technical Framework, defines content modules used in the IHE Devices profiles.

1.1 Introduction to IHE

Integrating the Healthcare Enterprise (IHE) is an international initiative to promote the use of standards to achieve interoperability among health information technology (HIT) systems and effective use of electronic health records (EHRs). IHE provides a forum for care providers, HIT experts and other stakeholders in several clinical and operational domains to reach consensus on standards-based solutions to critical interoperability issues.

The primary output of IHE is system implementation guides, called IHE Profiles. IHE publishes each profile through a well-defined process of public review and trial implementation and gathers profiles that have reached final text status into an IHE Technical Framework, of which this volume is a part.

For more general information regarding IHE, refer to www.ihe.net. It is strongly recommended that, prior to reading this volume, the reader familiarizes themselves with the concepts defined in the IHE Technical Frameworks General Introduction.

1.2 Intended Audience

The intended audience audience of IHE Technical Frameworks Volume 3 is:

- IT departments of healthcare institutions
- Technical staff of vendors participating in the IHE initiative
- Experts involved in standards development

1.3 Overview of Technical Framework Volume 3

The remainder of Section 1 further describes the general nature, purpose and function of the Technical Framework. Section 2 presents the conventions used in this volume to define IHE transactions.

Section 3 defines the general approach for defining device-related content. Subsequent sections address general content elements, as well as specifications for the content related to specific integration profiles and device specializations (e.g., ventilator). All of these address both terminology and information model specifications. These abstract semantic content specifications may then be bound to IHE profile implementations, including the “payload” in transactions, as well as content modules in documents. In some cases this content may be mandatory for a given exchange, and in others it may be used as the result of a profile option.

The appendices following the main body of this volume provide technical details associated with the semantic content specifications.

For a brief overview of additional Technical Framework Volumes (TF-1, TF-2, TF-4), please see the IHE Technical Frameworks General Introduction, Section 5 - Structure of the IHE Technical Frameworks.

1.4 Comment Process

IHE International welcomes comments on this document and the IHE initiative. Comments on the IHE initiative can be submitted by sending an email to the co-chairs and secretary of the Devices domain committees at dev@ihe.net. Comments on this document can be submitted at http://ihe.net/DEV_Public_Comments/.

1.5 Copyright Licenses

IHE technical documents refer to, and make use of, a number of standards developed and published by several standards development organizations. Please refer to the IHE Technical Frameworks General Introduction, Section 9 - Copyright Licenses for copyright license information for frequently referenced base standards. Information pertaining to the use of IHE International copyrighted materials is also available there.

1.6 Trademark

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1.7 Disclaimer Regarding Patent Rights

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1.8 History of Document Changes

This section provides a brief summary of changes and additions to this document.

Date	Document Revision	Change Summary
NOV 2024	10.0	Updates due to Patient Care Device name change to Devices and to coincide with latest template version.

2 Conventions

This document has adopted the following conventions for representing the framework concepts and specifying how the standards upon which the IHE Technical Framework is based shall be applied.

2.1 Content Module Modeling and Profiling Conventions

In order to maintain consistent documentation, modeling methods for IHE content modules and profiling conventions, for frequently used standards, are maintained in the IHE Technical Frameworks General Introduction, Appendix E - Standards Profiling and Documentation Conventions. Methods described include the standards conventions DICOM, HL7 v2.x, HL7 Clinical Document Architecture (CDA) Documents, etc. These conventions are critical to understanding this volume and should be reviewed prior to reading this text.

2.2 Additional Standards Profiling Conventions

This section defines profiling conventions for standards which are not described in the IHE Technical Frameworks General Introduction.

Not applicable.

3 Overview of device semantic content profiling

Though the transactions and messages defined in TF-2 provide for syntactic interoperability, in order to achieve semantic interoperability, each class of device must use the same terminology and data organization or modeling for common information. This TF-3 defines common abstract semantics or content profiles for patient care devices that fall within this domain. The semantics are based on the ISO/IEEE 11073-10101 nomenclature/terminology and the ISO/IEEE 11073-10201 domain information model, with additional semantics systems specified as appropriate (e.g., LOINC or SNOMED-CT), either as mappings to ISO/IEEE concepts or independently for non-mappable concepts. Other sections of the Devices Technical Framework define the mapping of these semantics to the information technologies defined for each transaction (for example, the TF-2 (Appendix A) *Mapping ISO/IEEE 11073 Domain Information Model to HL7*).

Note that this content specification is not intended to be exhaustive – the referenced standards should be consulted for more complete information.

In general, if a concept is not specified in this volume nor in the base standards (e.g., IEEE 11073-10101), a request should be made to the appropriate standards development organization (“SDOs”) to consider the additional concepts. Typically, this may be accomplished without significant delays, and if necessary, temporary term codes provided. See discussions below for additional information.

3.1 General device content considerations

This section addresses those issues that are transitive across all device types. Subsequent sections integrate these considerations as applicable to specific device specializations.

3.1.1 Hierarchical containment tree information

Each data item associated with a device specialization is specified within the context of its “containment tree” – all parameters are formalized either as attributes of a given object, or as instances of data objects that are contained within other objects in accordance to the following basic hierarchy[3]:

[3] See ISO/IEEE 11073-10201 Domain Information Model for complete details on these and other objects.

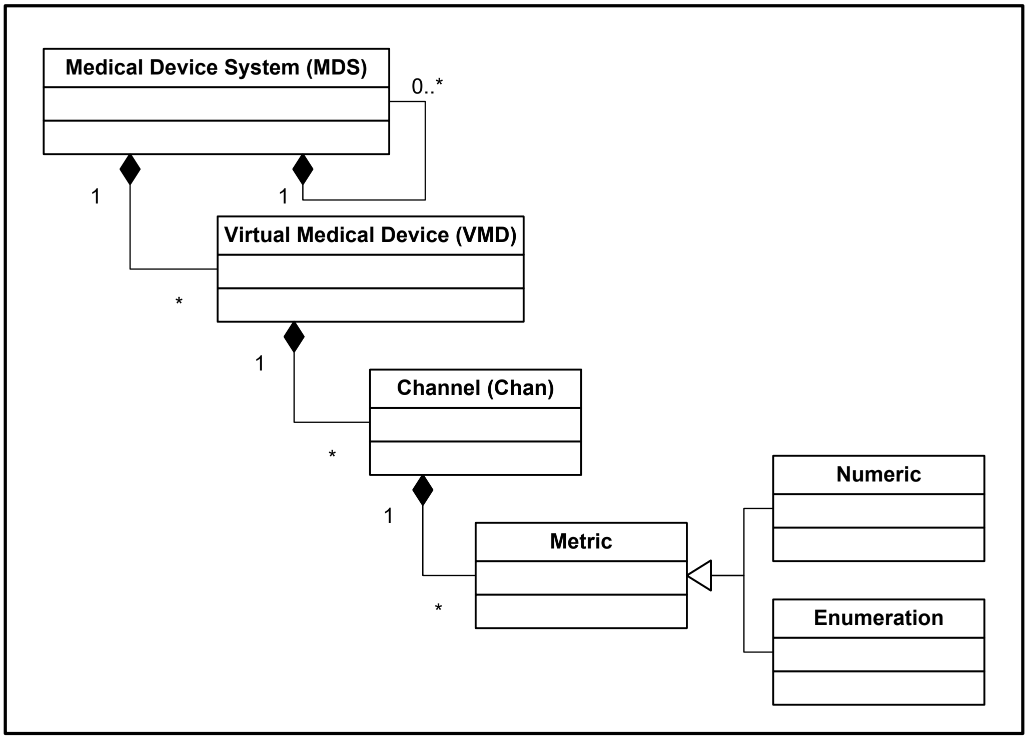

Figure 3.1.1-1: Basic ISO/IEEE 11073 Containment Tree

There are many additional objects defined in the ISO/IEEE 11073 information model (e.g., waveform and alarm / alert monitoring objects); however, for the purposes of this technical framework, only the above objects are utilized. Each object provides the following:

Medical Device System Top level object that establishes the overall context for all device data. In addition to a basic device name (e.g., Ventilator), this object includes attributes for a unique identifier (e.g., EUI-64), manufacturer and model, subcomponent serial numbers, device date and time, A/C power status, battery charge level, locale, etc. Note that an MDS may contain additional MDS objects. This would be the case when, for example, a physiological monitor integrates additional devices such as external infusion pumps and ventilators.[4]

Virtual Medical Device Supports a particular device specialization that may contain multiple channels and reflects a basic device building

[4] Not shown here are the 4 MDS specializations: Simple MDS (contains a single VMD instance), Hydra MDS (contains multiple VMD instances); Composite Single Bed MDS (contains embedded MDSs for a single patient); and Composite Multi Bed MDS (multiple MDSs for multiple patients), identified in the ISO/IEEE 11073-10201 standard. None of these specialization objects add any attribution – they only reflect the relationships between the MDS and other objects (namely, other MDSs, VMDs, and Patient Demographics).

	block. For example, an airway VMD may contain channels for pressure, flow, volume, and breath metrics. For devices with plug-in modules, each component is typically formalized by a VMD instance.
Channel	Provides for the aggregation of closely related data objects. For example, an infusion pump VMD may contain multiple fluid source channels, each with its own parameters for delivery rate, volume to be infused (“VTBI”), volume infused, drug label, etc.
Metric	This abstract class (it is only inherited by the specialization objects and may not be instantiated alone) provides a basic set of attributes for all the specialization objects. For example, status (e.g., available, disabled, etc.), body site list, measurement start/stop time, label, etc.
Numeric	Supports values that are represented as a numeric quantity (e.g., a set breath rate). Attributes include value, units, time stamp, ranges, resolution, etc. Compound values are supported where multiple values are realized in a single numeric (e.g., diastolic and systolic blood pressure is typically represented as a compound numeric value).
Enumeration	Supports parameters that are typically represented by a set of specified values. For example, a device’s operational mode may be represented by one of a finite set (e.g., for a ventilator the mode may be CPAP, SIMV, assist, etc.).

Though the sequential ordering of objects and attributes are typically not important (e.g., information from multiple VMDs in an MDS may be communicated in any order), the containment associations must be maintained. For example, multiple channels may have the same “infusion rate” parameter – if they are not properly associated to the right channel, then the information will not be correctly interpreted. Additionally, containment is strictly enforced (e.g., an Enumeration instance may not be contained directly under a VMD or MDS without a Channel).

For each of the device specializations specified below, the containment tree associated with each device and parameter is specified sufficiently to ensure proper communication when the information is exchanged in a transaction (MDS → VMD → Channel → Parameter); however, for some devices, though the containment relationships are fully specified, they may not be necessary (save the top level MDS that identifies the device source) – there is a single instance of the parameter for the entire device. In these cases, the actual information communicated by a given transaction may be limited to the individual parameters grouped together within a single medical device system containment.

3.1.2 Device semantics & controlled terminologies

Specific device semantics are formalized as a combination of terminology / vocabulary codes organized according to a common information model. The containment tree discussion above presented the basic ISO/IEEE 11073 information model used to organize and associate various device parameters. Terminologies are required, though, to represent each concept that is communicated. For example, an infusion rate may be communicated as "100 mL/Hr". At least two terms are required, one for the parameter name ("infusion rate") and one for the units of measurement ("mL/Hr"). In the device specialization sections below, all of the required semantics are specified, so as to ensure that the same term set is used for a given class of device.

3.1.3 Overview of the ISO/IEEE 11073 nomenclature/terminology

The ISO/IEEE 11073-10101 (and related) nomenclature is optimized for medical device (esp. acute care) semantics, containing an extensive set of term codes supporting the information model, device parameters, units of measurement, body sites, alert events, etc. Each term in this system is formalized as a text-based Reference Identifier and a 16-bit or 32-bit numeric code. The 16-bit code is "context sensitive" in that it may be used when you know the class of information that it represents. For example, if in a message a field is being processed that represents Units of Measurement, then the 16-bit numeric code may be used, given that the semantic context has been established. The 32-bit code is "context free" in that it is guaranteed to be unique across the entire terminology.

All text-based Reference ID's are formalized as a contiguous string of either capitalized letters or underscores ("_"). For example, MDC_RESP_RATE or MDC_PULS_RATE. Note that the prefix "MDC" stands for medical device communication, and is often used to identify this nomenclature (e.g., "MDC" is used in HL7 to identify terms from this standard).

By convention, this Technical Framework will specify 11073 terms using the following format:

<Ref ID> (<partition[5] or code block>::<16-bit term code>)

For example, the two terms above would be specified as follows:

MDC_RESP_RATE (2::20490)

MDC_PULS_RATE (2::18442)

To determine the 32-bit value: <partition> * 2^16 + <16-bit term code>. So the pulse rate code above would have a 32-bit representation of 18444 (or hex 0x0002480A). The mapping rules for a given transaction technology shall indicate whether the textual Reference ID, 32-bit, or 16-bit codes may be used and how to properly encoded the terms (e.g., whether the numeric codes are formatted as text or binary values).

If additional or alternative terms are needed from other systems, such as LOINC or SNOMED-CT, they will be specified as well.

3.1.4 Private terms and scope

Some devices communicate concepts that are either not standardized (in any terminology system) or are private and should only be recognized by applications that are aware of this device's specific semantics. In this case, the 11073 terminology provides for "private" sections

[5] Note: Partition numbers are defined in ISO/IEEE 11073-10101, Section B.1.2, or in ISO/IEEE 11073-10201, type *NomPartition* definition.

of the terminology where manufacturers may define these semantics without worry of overlapping other terms already assigned. The 16-bit range from 0xF000 to 0xFFFF (hex) for each code block is reserved for private terms. If an entire private block of terms (65536 items) is required, the partition 1024 may be used.

In complex environments, though, where multiple devices are connected to a single patient and where two or more vendors may define terms with the same private codes (i.e., even the 32-bit identifier may not be unique), it is necessary to ensure proper scoping of these terms to ensure there are no collisions. To accomplish this, the scope associated with any private codes is defined by the containing VMD. This allows for modular systems where different plug-in components may be from different manufacturers.

3.1.5 New or non-specified terms

Additional terminology not contained in the device specializations below may:

- Exist in a terminology and simply hasn't been included in this version of the Framework, **or**
- Be a new concept that should be standardized (e.g., resulting from a new device modality),

  or
- Is a private or custom term that is particular to a single manufacturer's device and should not necessarily be standardized.

In the first case, change requests may be submitted to this Technical Framework to have the needed semantics added. In general, if the semantics exist (either as terms and/or attributes in the Domain Information Model, they may be used in transactions without being added to this content specification; however, in order to achieve semantic interoperability and heterogeneity with a class of device, there must be agreement regarding the way a given concept is represented.

In the second case, new terms may be submitted to the relevant standard group for consideration. For these, either a pre-assigned term may be used or a private term until standardization is complete.[6]

In the third case, a private code should be used and is out-of-scope for inclusion in this content specification.

3.1.6 Episodic vs. periodic data updates

Device information is typically reported in a manner appropriate for the given parameter and consuming application. Data reporting modes include:

- Periodically – for parameters that change or are updated regularly. For example, the volume delivered on an infusion pump changes regularly based on the fluid delivery rate.

[6] Note: The ISO/IEEE 11073 group has indicated that it will make a best effort to address all new term requests as quickly as possible and where appropriate to provide rapid assignment of Reference IDs and term codes.

- Periodically High-Frequency – for data that is reported periodically but at high data rates. For example, physiological waveforms.
- Episodically – for parameters that change infrequently or based on an external event. For example, an operational setting is modified by the clinician or a breath or heart beat has been detected.
- Snap-shot – for those applications that only request the current value of a device's information at infrequent intervals. For example, once every 10 minutes or an hour.

Where appropriate, the device parameter specifications below shall indicate whether a particular item is updated periodically or episodically. In the ISO/IEEE 11073 information model, the Metric::MetricRelevance and Metric::MetricAccess provide this information.

In the ISO/IEEE 11073 information model, provision for creating data updates or "event reports" for these various methods fall to a number of "extended services" objects such as an episodic scanner, periodic scanner, or fast periodic scanner. Each instance of these objects "scans" a configured list of data items and when changes are detected, generates an update including those parameters. For example, a "breath" episodic scanner instance would report all breath-to-breath related parameters (e.g., I:E ratio, inspiratory time, peak inspiratory pressure, etc.) whenever a breath completion has been detected.

Depending on the transaction profile conveying the device data, identification of these update classes may be supported. If so, the following terms should be used to differentiate the update type being reported:

Table 3.1.6-1: Update Report Type Identification

Update Report Type Identification	
Update Type	**Term Code**
Episodic Update	MDC_NOTI_UNBUF_SCAN_RPT (1:: 3350)
Periodic Update	MDC_NOTI_BUF_SCAN_RPT (1:: 3331)

3.1.7 Alternative units of measurement mapping

Though the basic units of measurement specified in this technical framework are from the ISO/IEEE 11073-10101 Units of Measurement partition, mappings to alternative terminology systems may be required for some implementations of this technical framework. For each parameter in the device specializations that includes a unit of measurement specification, the ISO/IEEE term is called out. The following table provides a summary of all the units of measurement terms utilized by this framework and provides for their mapping to alternative systems

Table 3.1.7-1: ISO/IEEE 11073 Alternative Units Mapping

ISO/IEEE 11073 Alternative Units Mapping				
ISO/IEEE 11073	**UCUM**	**LOINC**	**SNOMED-CT**	**Discussion**
MDC_DIM_CM_H2O (4::3904)				cmH_2O
MDC_DIM_MICRO_G_PER_HR (3379)				μG/hr
MDC_DIM_MICRO_G_PER_MIN (3347)				μG/min
MDC_DIM_MILLI_G_PER_HR (3378)				mG/hr
MDC_DIM_MILLI_G_PER_MIN (3346)				mG/min
MDC_DIM_MILLI_L (4::1618)				mL
MDC_DIM_MIN (4:2208)				minutes
MDC_DIM_PERCENT (4::544)				%
MDC_DIM_RESP_PER_MIN (4::2784)				rpm
MDC_DIM_SEC (4::2176)				seconds
MDC_DIM_X_INTL_UNIT_PER_HR (5696)				i.u./hr
MDC_DIM_X_L_PER_MIN (4::3072)				L/min

3.2 Alert and event semantics

Most medical devices provide indications of event or alert conditions. These are typically technical (e.g., a sensor needs to be calibrated or has been detached from the device), or physiological (e.g., a patient's spontaneous breath rate is too high). There is also a prioritization associated with alert conditions (low, medium and high), and each device specifies the prioritization within a given class (e.g., if a device has 10 high priority alerts, and three are active, which is the highest priority of the three?).

Additionally, an alert condition may be associated with the entire device (e.g., low battery), a particular channel (e.g., occlusion on infusion channel #2), or a specific parameter (e.g., heart rate too high). When communicated, the alert conditions should be associated with the appropriate device scope or entity within the device's information containment tree or hierarchy. When associated with a given parameter (e.g., a monitored temperature or pressure reading), generic event codes are preferred over more specific terms. For example, "low" or "high" or "irregular" as associated with a monitored heart rate parameter vs." high beat rate" and "low beat rate", etc. In most cases, though, specific codes must be used, such as "gas contaminated" or "asystole".

Though some of these semantics are particular to a specific device, most are general and may be applied to multiple devices. The following table provides examples of common alert semantics that may be used in this TF[7]:

Table 3.2-1: Device Alert Event Semantics

Device Alert Event Semantics	
Description	**Term Code**
General Events	
Alarm	MDC_EVT_ALARM (3::8)
Disconnected	MDC_EVT_DISCONN (3:22)
Empty	MDC_EVT_EMPTY (3::26)
Error	MDC_EVT_ERR (3::30)
Failure	MDC_EVT_FAIL (3::38)
High	MDC_EVT_HI (3::40)
High – Greater than set limit	MDC_EVT_HI_GT_LIM (3::42)
INOP (device is inoperable)	MDC_EVT_INOP (3::52)
Low	MDC_EVT_LO (3::62)
Low – Less than set limit	MDC_EVT_LO_LT_LIM (3::64)
Occlusion	MDC_EVT_OCCL (3::80)
Range Error	MDC_EVT_RANGE_ERR (3::164)
Door / Handle Position Problem	MDC_EVT_DOOR_OR_HANDLE_POSN_PROB (3::234)
Fluid Line Problem	MDC_EVT_FLUID_LINE_PROB (3::252)

[7] For a more complete listing of device alert semantics, see ISO/IEEE 11073-10101 Section A.9 *Nomenclature, data dictionary, and codes for alerts (Block E)*, or Annex B.4 in the same standard.

Device Alert Event Semantics	
Description	**Term Code**
General Events	
Gas is contaminated	MDC_EVT_GAS_CONTAM (3::256)
Lead is off / disconnected	MDC_EVT_LEAD_OFF (3::272)
Sensor problem	MDC_EVT_SENSOR_PROB (3::312)
Low signal level	MDC_EVT_SIG_LO (3::380)
Timeout	MDC_EVT_TIMEOUT (3::584)
Physiological/Medical Events	
Apnea	MDC_EVT_APNEA (3::3072)
Asystole	MDC_EVT_ECG_ASYSTOLE (3::3076)
Sustained Bradycardia	MDC_EVT_ECG_BRADY_SUST (3::3088)
Tachycardia	MDC_EVT_ECG_TACHY (3::3120)
Arrhythmia	MDC_EVT_ECG_ARRHY (3::3266)
Technical Events	
Battery failed	MDC_EVT_BATT_FAIL (3::192)
Low Battery	MDC_EVT_BATT_LO (3::194)
Battery Malfunction	MDC_EVT_BATT_MALF (3::196)
Pressure cuff leak	MDC_EVT_CUFF_LEAK (3::228)
Pressure cuff position error	MDC_EVT_CUFF_POSN_ERR (3::430)
Pump in Free Flow	MDC_EVT_PUMP_FLOW_FREE (3::598)
General Status Events	
Alarming Turned Off	MDC_EVT_STAT_AL_OFF (3::6144)
Alarming Turned On	MDC_EVT_STAT_AL_ON (3::6146)
Battery Charging	MDC_EVT_STAT_BATT_CHARGING (3::6150)
Standby Mode	MDC_EVT_STAT_STANDBY_MODE (3::6166)
Alarm Silence	MDC_EVT_STAT_AL_SILENCE (3::6214)
Door Open	MDC_EVT_STAT_DOOR_OPEN (3::6220)
Door Closed	MDC_EVT_STAT_DOOR_CLOS (3::6244)
Advisory Events	
Check Device	MDC_EVT_ADVIS_CHK (3::6658)
Check Settings	MDC_EVT_ADVIS_SETTINGS_CHK (3::6668)
Replace Battery	MDC_EVT_ADVIS_BATT_REPLACE (3::6678)
Replace Syringe Warning	MDC_EVT_ADVIS_PUMP_SYRINGE_REPLACE_WARN (3::6712)
Check Ventilator Air Supply	MDC_EVT_ADVIS_VENT_AIR_SUPP_CHK (3::6728)

Note: Private event codes may be used to define non-standardized events that are not contained in the table above or in the base ISO/IEEE 11073-10101 standard. Any use of private event codes should be clearly described in the device's documentation.

3.3 Body site semantics

One or more body sites may be associated with a given device parameter. For example, a temperature may have the same term codes, but are differentiated by the location of the where the temperature is taken. Other parameters (especially EEG and BIS measurements) are derived from signals from multiple sites. The ISO/IEEE 11073 Metric object includes an attribute listing body sites, either from the base 11073-10101 terminology or from other vocabularies. The following table provides some examples of body sites that may be associated with a device parameter:

Table 3.3-1: Body Site Terms

Body Site Terms	
Description[8]	**Term Code**
Left ear (theta 120, phi 180)	MDC_HEAD_EAR_L (7::1289)
Right ear (theta 120, phi 0)	MDC_HEAD_EAR_R (7::1290)
Electrode 1 cm above the right eye on the eyebrow, in the middle between the center point of the eye and the lateral canthus.	MDC_EYE_CANTH_LAT_ABOVE_R (7::1362)
Subarachnoid, Left [T-X1502-LFT] (for neurological measurements and drainage)	MDC_BRAIN_SUBARACHNOIDAL (7::1412)
Left Atrium [T-32300]	MDC_HEART_ATR_L (7::1429)
Right Ventricle [T-32500]	MDC_HEART_VENT_R (7::1442)
Umbilical Artery [T-88810]	MDC_ART_UMBILICAL (7::1480)
Lower extremity, Great toe [T-Y9810]	MDC_LOEXT_TOE_GREAT (7::1620)
Upper extremity, Ring finger, NOS [T-Y8840]	MDC_UPEXT_FINGER_RING (7::1764)
Vena umbilicalis [T-49062] (child) (e.g., for fluid therapy)	MDC_VEIN_UMBILICAL_CHILD (7::1808)

3.4 Basic data type specifications

All communicated information must conform to common abstract data type specifications. The ISO/IEEE 11073-10201 standard defines data types for each object attribute using ASN.1 specification. The following listing identifies the data types used in this Technical Framework. When appropriate, the definition includes the analogous C/C++ constructs:

AbsoluteTime Date / Time specification as follows (BCD digits):

```
struct AbsoluteTime {
   UInt8 century;
   UInt8 year;
   UInt8 month;
   UInt8 day;
   UInt8 hour;
   UInt8 minute;
   UInt8 second;
```

[8] Bracketed identifiers in Descriptions indicate the analogous SNOMED code.


```
      UInt8 sec-fractions;
   }
```

BatMeasure Battery-related measurement:

```
struct BatMeasure {
   FLOAT-Type   value;
   OID-Type     units;
}
```

FLOAT-Type Basic numerical representation floating point representation, made up of a 24-bit signed magnitude and an 8-bit signed exponent, where:

value = (magnitude) * (10^exponent)

Special values are provided as follows:

Not a Number (NaN)	+(2^23-1)
Not at this Resolution (NRes)	-(2^23)
+INFINITY	+(2^23-2)
-INFINITY	-(2^23-2)

Int16 16-bit signed integer (*short int*)

Locale Specification of localization information for the device, including language and max string lengths[9]:

```
struct Locale {
   UInt32   language;  // From ISO 639-1 / 629-2
   UInt32   country;   // From ISO 3166-1, -2, -3
   UInt16   char-set;  // IANA MIBenum values
   StringSpec str-spec;// Max length + null term.
}
```

OID-Type 16-bit term code (context-sensitive portion)

ProdSpecEntry A specification of a production serial number or other configuration identifier:

```
struct ProdSpecEntry {
   TEXT[10]  spec_type;
   UInt16 component_id;  // Mfgr's ID
   TEXT   prod-spec;
}
```

TEXT A printable text string (*char []*); either counted or null terminated.

TYPE 32-bit context-free term code:

```
struct TYPE {
    UInt16  Partition;
    UInt16  Code;
}
```

UInt8 8-bit unsigned integer (*unsigned char*)

[9] For more complete details on the Locale data type, see the specification in ISO/IEEE 11073-10201.

[10] In the 11073-10201 standard, this is defined as an enumeration of UInt16 values, but for this framework it is specified as an identifying text string.

UInt16 16-bit unsigned integer (*unsigned short int*)

UInt32 32-bit unsigned integer (*unsigned long int*)

3.5 MDS semantics

Parameters for each device specialization are contained within an MDS containment hierarchy. The following table describes some of those attributes defined by an MDS which may be applicable for any of the devices specified below:

Table 3.5-1: Medical Device System (MDS) Attributes

Medical Device System (MDS) Attributes				
Attribute	**Description**	**Term Code**	**Data Type[11]**	**Values**
System-Type	General category of the device (e.g., infusion pump)	MDC_ATTR_SYS_TYPE (1::2438)	TYPE	For example, MDC_DEV_PUMP_INFUS_MDS (1::4449)
Mds-Status	Device's connection state (based on FSM)	MDC_ATTR_VMS_MDS_STAT (1::2471)	TEXT[12]	"disconnected", "associated", "configuring", "configured", "operating", "re-configuring", "disassociating", "terminating"
System-Model	Manufacturer & Model label strings	MDC_ATTR_ID_MODEL (1::2344)	SystemModel	manufacturer="Philips" model="IntelliVue MP70"
System-Id	Device unique identifier – typically EUI-64; top 24 bits = unique company ID; lower 40 bits = serialization code; related to MAC addresses.	MDC_ATTR_SYS_ID (1::2436)	TEXT	For example, "00-00-00-00-00-00-00-00", where each "00" represents a hexadecimal representation of a byte.
Soft-Id	Locally (non-manufacturer) ID (e.g., hospital inventory number)	MDC_ATTR_ID_SOFT (1::2350)	TEXT	"TMC Vent 42"
Production-Specification	List of serial numbers and other items such as GMDN code	MDC_ATTR_ID_PROD_SPECN (1::2349)	List of ProdSpecEntry	serial-number="XYZ12345" sw-revision="03.02.01"

[11] Data types are further defined in Section *3.4 Basic data type specifications*.
[12] For the purposes of this technical framework, this data type which is MDSStatus, an enumerated set of UInt16 values, is defined as a set of string values.

Medical Device System (MDS) Attributes				
Attribute	**Description**	**Term Code**	**Data Type[11]**	**Values**
Bed-Label	String identifying the bed to which the device has been assigned	MDC_ATTR_ID_BED_LABEL (1::2334)	TEXT	For example, “PICU 13”
Date-and-Time	Device’s current date / time setting	MDC_ATTR_TIME_ABS (1::2439)	AbsoluteTime	20, 06, 08, 14, 23, 43, 12, 34
Power-Status[13]	A/C or D/C	MDC_ATTR_POWER_STAT (1::2389)	TEXT[14]	“onMains”, “onBattery”, “chargingFull”, “chargingTrickle”, “chargingOff”
Battery-Level	***Percentage*** of battery capacity remaining	MDC_ATTR_VAL_BATT_CHARGE (1::2460)	UInt16	50 %
Remaining-Battery-Time	Estimated battery run-time remaining (typically in minutes)	MDC_ATTR_VAL_BATT_REMAIN (1::2440)	BatMeasure	120.5 MDC_DIM_MIN (4:2208)
Altitude	In meters above / below sea level	MDC_ATTR_ALTITUDE (1::2316)	Int16	120
Locale	Structure defining the device’s country, language and character setting	MDC_ATTR_LOCALE (1::2600)	Locale	language = 0x656E0000 (“en”), country = 0x55530000 (“US”), charset = charset-iso-10646-ucs-2(1000), str-spec { str-max-len = 0x0040, str-flags = str-flag-nt(0) [0x8000] }

3.6 VMD semantics

Each MDS contains one or more Virtual Medical Devices (VMD). As stated above, a VMD may be used to represent either a major functional unit within a device (e.g., a ventilator may have one VMD to contain settings and general operational parameters and another as an Airway monitor or Airway Gas Analyzer). Additionally, VMDs typically represent units that may be plugged into other

[13] A separate battery object is defined in the 11073-10201 standard for systems that report more advanced battery information.
[14] This attribute is defined as a PowerStatus enumeration; however, for this Technical Framework, the value strings are defined.

devices such as physiological monitors. The attributes in the following table apply to all VMD instances in the device specializations defined below:

Table 3.6-1: Virtual Medical Device (VMD) Attributes

Virtual Medical Device (VMD) Attributes				
Attribute	**Description**	**Term Code**	**Data Type**[15]	**Values**
Type	General category of the VMD (e.g., infusion pump)	MDC_ATTR_ID_TYPE (1::2351)	TYPE	For example, MDC_DEV_SYS_PT_VENT_VMD (1::4466)
VMD-Status	VMD's basic operational status	MDC_ATTR_VMD_STAT (1::2466)	TEXT[16]	"vmd-off", "vmd-not-ready", "vmd-standby", "vmd-transduc-discon", "vmd-hw-discon"
VMD-Model	Manufacturer & Model label strings	MDC_ATTR_ID_MODEL (1::2344)	SystemModel	manufacturer="Philips" model="IntelliVue MP70"
Production-Specification	List of serial numbers and other items such as GMDN code	MDC_ATTR_ID_PROD_SPECN (1::2349)	List of ProdSpecEntry	serial-number="XYZ12345" sw-revision="03.02.01"
Position	Physical "slot" that the VMD is plugged into	MDC_ATTR_ID_POSN (1::2348)	UInt16	3
Locale	Structure defining the device's country, language and character setting.	MDC_ATTR_LOCALE (1::2600)	Locale	Same as MDS above.

3.7 Channel semantics

Channels provide aggregation for closely related parameters. For devices that contain "channels" (e.g., ECG channels or infusion pump fluid channels), these definitions provide a means for differentiating parameters with identical term codes (e.g., fluid source channel rate or volume infused) but contained in different channels. The attributes in the following table apply to all Channel instances in the device specializations defined below:

[15] Data types are further defined in Section *3.4 Basic data type specifications.*
[16] For the purposes of this technical framework, this data type which is VMDStatus, an enumerated set of bit flags, is defined as a set of string values; multiple of these may be active at the same time.

Table 3.7-1: Channel Attributes

Channel Attributes				
Attribute	**Description**	**Term Code**	**Data Type**[17]	**Values**
Type[18]	General category of the VMD (e.g., infusion pump)	MDC_ATTR_ID_TYPE (1::2351)	TYPE	For example, MDC_DEV_SYS_PT_VENT_VMD (1::4466)
Channel-Status	Channel's operational status	MDC_ATTR_CHAN_STAT (1::2320)	TEXT[19]	"chan-off", "chan-not-ready", "chan-standby", "chan-transduc-discon", "chan-hw-discon"
Physical-Channel-No	Numeric ID of a hardware channel	MDC_ATTR_CHAN_NUM_PHYS (1::2319)	UInt16	12
Logical-Channel-No	Dynamically assigned channel number; for channels that may have an assignment that changes due to reconfiguration.	MDC_ATTR_CHAN_NUM_LOGICAL (1::2606)	UInt16	3

[17] Data types are further defined in Section *3.4 Basic data type specifications*.
[18] Note: A Channel-Type attribute has been proposed, which would allow for parameters such as "secondary infusion channel".
[19] For the purposes of this technical framework, this data type which is ChannelStatus, an enumerated set of bit flags, is defined as a set of string values. Multiple flags can be asserted at the same time.

4 Reserved

Section reserved for future updates.

Editor's Note*: This section is reserved for the Rosetta Terminology Mapping data set specifications. Implementation details such as file specification and design may be captured in an appendix.*

5 Reserved

This section is reserved for future updates.

Editor's Note*: This section is reserved for non-profile specific content modules (e.g., value set specifications) such as for Device Specialization – General.*

6 Reserved

This section is reserved for future updates.

Editor's Note*: This section is reserved for profile specific content modules such as for ACM or MEM/CMMS. Note that Device Specialization profiles have their own section.*

7 Device specialization content modules

The content module specifications in this section focus on typical device classes or "modalities" that are often found in healthcare delivery and that directly support device specialization integration profiles.

7.1 Device: Infusion Pump

> ***Editor's Note****: This section will be updated with the content from the Device Specialization – Infusion Pump Profile that is currently under development.*

7.1.1 Containment tree

Infusion pumps organize their information as follows:

Table 7.1.1-1: Infusion Pump Containment Tree

Infusion Pump Containment Tree			
MDS: Infusion Pump			MDC_DEV_PUMP_INFUS_MDS (1::4449)
	VMD: Infusion Pump		MDC_DEV_PUMP_INFUS_VMD (1::4450)
		Channel: Source	MDC_DEV_PUMP_INFUS_CHAN_SOURCE (1::61441)
		Channel: Delivery	MDC_DEV_PUMP_INFUS_CHAN_DELIVERY (1::61442)

For devices that support a secondary or "piggy-back" channel, two Source channels should be defined, one as the primary channel, and one as the secondary. In other words, source channels are defined for each fluid that is routed to a given delivery or distal path. An infusor VMD shall have one and only one delivery channel. Devices that contain multiple delivery channels shall define multiple infusor VMD instances.

7.1.2 Channel: Source

Fluid source infusion channels may contain the following parameters:

Table 7.1.2-1: Infusor Source Channel Parameters

Infusor Source Channel Parameters				
Name	**Term Code**	**Data Type**	**Units**	**Values**
Set Fluid Delivery Rate	MDC_FLOW_FLUID_PUMP (2::26712)	Numeric::FLOAT	MDC_DIM_MILLI_L_PER_HR (4::3122)	
Remaining VTBI	MDC_VOL_FLUID_TBI_REMAIN (2::26800)	Numeric::FLOAT	MDC_DIM_MILLI_L (4::1618)	
Duration	MDC_TIME_PD_REMAIN (2::26844)	Numeric::FLOAT	MDC_DIM_MIN (4::2208)	

Infusor Source Channel Parameters				
Name	**Term Code**	**Data Type**	**Units**	**Values**
Drug Dose Rate	MDC_FLOW_DRUG_DELIV (2::26732)	Numeric::FLOAT	MDC_DIM_MILLI_G_PER_HR 4:: (3378) / MDC_DIM_MILLI_G_PER_MIN (4::3346) / MDC_DIM_MICRO_G_PER_HR (4::3379) / MDC_DIM_MICRO_G_PER_MIN (4::3347) / MDC_DIM_X_INTL_UNIT_PER_HR (4::5696)	
Volume Infused	MDC_VOL_FLUID_DELIV (2::26792)	Numeric::FLOAT-Type	MDC_DIM_MILLI_L (4::1618)	
Drug Label	MDC_DRUG_NAME_TYPE (2::53258)	Enumeration::TEXT	N/A	

7.1.3 Channel: Delivery

Fluid delivery infusion channels may contain the following parameters:

Table 7.1.3-1: Infusor Delivery Channel Parameters

Infusor Delivery Channel Parameters				
Name	**Term Code**	**Data Type**	**Units**	**Values**
Total Current Rate	MDC_FLOW_FLUID_PUMP (2::26712)	Numeric::FLOAT-Type	MDC_DIM_MILLI_L_PER_HR (4::3122)	
Total Volume Infused	MDC_VOL_INFUS_ACTUAL_TOTAL (2::26876)	Numeric::FLOAT-Type	MDC_DIM_MILLI_L (4::1618)	
Operational Status	MDC_PUMP_STAT (2::53436)	Enumeration::TEXT [20]	N/A	"pump-status-infusing" + "pump-status-kvo" + "pump-status-ready" +" pump-status-standby" + "pump-status-paused"
Operational Mode	MDC_PUMP_MODE (2::53432)	Enumeration::TEXT [20]	N/A	"pump-mode-nominal" + "pump-mode-secondary" + "pump-mode-drug-dosing"

[20] This parameter is specified as a set of bit flags, but for this technical framework, the enumerated text strings shall be used.

7.2 Device: Ventilator

***Editor's Note**: This section will be updated with the results of the on-going ventilator working group efforts (in conjunction with ISO TC121 and ISO/IEEE 11073); this effort should also ultimately result in a Device Specialization – Ventilator Integration Profile that will then totally replace the content in this section. The information that is currently here tracks the results of the IEEE 11073 ventilator specialization group that was working on the ISO/IEEE 11073-10303 standard.*

7.2.1 Containment tree

Ventilators organization their information according to the following containment tree:

Table 7.2.1-1: Ventilator Containment Tree

Ventilator Containment Tree			
MDS: Ventilator			MDC_DEV_SYS_PT_VENT_MDS (1::4465)
	VMD: Ventilator		MDC_DEV_SYS_PT_VENT_VMD (1::4466)
		Channel: Ventilator	MDC_DEV_SYS_PT_VENT_CHAN (4467)
		Channel: Nebulizer	
	VMD: Airway Multi-Parameter		MDC_DEV_ANALY_AWAY_MULTI_PARAM_VMD (1::4146)
		Channel: Pressure	MDC_DEV_ANALY_PRESS_AWAY_CHAN (1::4171)
		Channel: Flow	MDC_DEV_ANALY_FLOW_AWAY_CHAN (1::4131)
		Channel: Volume	MDC_DEV_ANALY_VOL_AWAY_CHAN (1::61452)
		Channel: Breath Pattern	MDC_DEV_ANALY_BREATH_PATTERN_CHAN (1::61456)
	VMD: Pulse-Oximeter		
		Channel: Pulse-Ox	
		Channel: Pulse Rate	
	VMD: Airway Gas Analyzer		
		Channel: Oxygenation	
		Channel: NO/NO_2	
		Channel: CO_2	
		Channel: Resp CO_2	
		Channel: Anesthesia Agent	

7.2.2 Channel: Ventilator

The ventilator channel contains the following semantics:

Table 7.2.2-1: Ventilator Channel Parameters

Ventilator Channel Parameters				
Name	**Term Code**	**Data Type**	**Units**	**Values**
Operational Mode	MDC_VENT_MODE (2::53280)	Enumeration::TEXT [20]	N/A	“vent-mode-cpap” + “vent-mode-simv” + “vent-mode-insp-assist”
Set Breath Rate	MDC_RESP_RATE (2::20490)	Numeric::FLOAT-Type	MDC_DIM_RESP_PER_MIN (4::2784)	
Set Tidal Volume	MDC_VOL_AWAY_TIDAL_EXP (2::61454)	Numeric::FLOAT-Type	MDC_DIM_MILLI_L (4::1618)	
Set Peak Inspiratory Flow	MDC_VENT_FLOW_INSP (2::61440)	Numeric::FLOAT-Type	MDC_DIM_X_L_PER_MIN (4::3072)	
Set PEEP	MDC_PRESS_AWAY_END_EXP_POS (2::20732)	Numeric::FLOAT-Type	MDC_DIM_CM_H2O (4::3904)	
Set Inspiratory Time	MDC_TIME_PD_INSP (2::61458)	Numeric::FLOAT-Type	MDC_DIM_SEC (4::2176)	
Set Inspiratory Pause	MDC_VENT_TIME_PD_PAUSE_INSP (2::61443)	Numeric::FLOAT-Type	MDC_DIM_SEC (4::2176)	
Set Flow Shape	MDC_VENT_FLOW_SHAPE (2::61449)	Enumeration::TEXT	N/A	“waveform-shape-square”; “waveform-shape-decelerating”
Set FiO2	MDC_VENT_CONC_AWAY_O2 (2::20648)	Numeric::FLOAT-Type	MDC_DIM_PERCENT (4::544)	

7.2.3 Channel: Airway Pressure

The airway pressure channel includes the following parameters:

Table 7.2.3-1: Airway Pressure Channel Parameters

Airway Pressure Channel Parameters				
Name	**Term Code**	**Data Type**	**Units**	**Values**
Peak Inspiratory Pressure (PIP)	MDC_PRESS_AWAY_INSP_PEAK (2::20745)	Numeric::FLOAT-Type	MDC_DIM_CM_H2O (4::3904)	
Mean Airway	MDC_PRESS_AWAY_MEAN (2::61451)	Numeric::FLOAT-Type	MDC_DIM_CM_H2O (4::3904)	

Airway Pressure Channel Parameters				
Name	**Term Code**	**Data Type**	**Units**	**Values**
Pressure (MAP)				
PEEP	MDC_PRESS_AWAY_END_EXP_POS (2::20732)	Numeric::FLOAT-Type	MDC_DIM_CM_H2O (4::3904)	

7.2.4 Channel: Airway Volume

The airway volume channel includes the following parameters:

Table 7.2.4-1: Airway Volume Channel Parameters

Airway Volume Channel Parameters				
Name	**Term Code**	**Data Type**	**Units**	**Values**
Exhaled Tidal Volume	MDC_VOL_AWAY_TIDAL_EXP (2::61454)	Numeric::FLOAT-Type	MDC_DIM_MILLI_L (4::1618)	
Exhaled Minute Volume	MDC_VOL_AWAY_MINUTE_EXP (2::61455)	Numeric::FLOAT-Type	MDC_DIM_X_L (4::1600)	

7.2.5 Channel: Airway Breath Pattern

The airway breath pattern channel includes the following parameters:

Table 7.2.5-1: Airway Breath Pattern Channel Parameters

Airway Breath Pattern Channel Parameters				
Name	**Term Code**	**Data Type**	**Units**	**Values**
I:E Ratio	MDC_RATIO_IE (2::20760)	Numeric::Compound::FLOAT-Type	MDC_DIM_DIMLESS (4::512)	
	MDC_RATIO_INSP (2::61461)			
	MDC_RATIO_EXP (2::61462)			
Breath Rate	MDC_RESP_RATE (2::20490)	Numeric::FLOAT-Type	MDC_DIM_RESP_PER_MIN (4::2784)	
Inspiratory Time	MDC_TIME_PD_INSP (2::61458)	Numeric::FLOAT-Type	MDC_DIM_SEC (4::2176)	

7.3 Device: Physiologic Monitor

***Editor's Note**: The information that is in this section tracks the results of the IEEE 11073 physiological monitor specialization group that was working on the ISO/IEEE 11073-10302 standard. It is anticipated that ultimately, this section shall be replaced by a Device Specialization – Physiological Monitor Integration Profile. Note that many of the Channel sections below contain empty tables. The content is exactly as it has been published previously within the DEV TF-2 Appendix D. The original intent was to add exemplar parameters into these tables; however, that activity was never undertaken. It could be the subject of a fairly simple CP to TF-3 though.*

7.3.1 Containment tree

Physiological monitors are comprised of a number of different VMDs as indicated in the following containment tree:

Table 7.3-1: Physiological Monitor Containment Tree

Physiological Monitor Containment Tree			
MDS: Physiological Monitor			MDC_DEV_METER_PHYSIO_MULTI_PARAM_MDS (1::4301)
	VMD: Blood Pressure		MDC_DEV_METER_PRESS_BLD_VMD (1::4318)
		Channel: Invasive BP	MDC_DEV_METER_PRESS_BLD_CHAN (1::4319)
		Channel: Non-Invasive BP	MDC_DEV_PRESS_BLD_NONINV_CHAN (1::5151)
		Channel: Pulse Rate BP	
	VMD: Temperature		MDC_DEV_METER_TEMP_VMD (1::4366)
		Channel: Temperature	MDC_DEV_METER_TEMP_CHAN (1::4367)
	VMD: Pulse-Oximeter		MDC_DEV_ANALY_SAT_O2_VMD (1::4106)
		Channel: Pulse-Ox	MDC_DEV_ANALY_SAT_O2_CHAN (1::4107)
		Channel: Pulse Rate Ox	
	VMD: ECG Monitor		MDC_DEV_ECG_VMD (1::4262)
		Channel: ECG	MDC_DEV_ECG_CHAN (1::4263)
		Channel: ECG Resp	MDC_DEV_ECG_RESP_CHAN (1::5131)
		Channel: Heart Rate	MDC_DEV_GEN_RATE_HEART_CHAN (1::4251)
		Channel: Arrhythmia	MDC_DEV_ARRHY_CHAN (1::5135)
		Channel: Ischemia	
		Channel: ECG Measurements	
	VMD: Cardiac Output		MDC_DEV_ANALY_CARD_OUTPUT_VMD (1::4134)
		Channel: Continuous CO	
		Channel: Intermittent CO	
	VMD: Hemodynamics Calculator		MDC_DEV_CALC_HEMO_VMD (1::4210)
		Channel: Hemodynamics Calc.	MDC_DEV_CALC_HEMO_CHAN (1::4211)

7.3.2 Channel: Invasive Blood Pressure

Invasive blood pressure channels may contain the following parameters:

Table 7.3.2-1: Invasive Blood Pressure Channel Parameters

Invasive Blood Pressure Channel Parameters				
Name	**Term Code**	**Data Type**	**Units**	**Values**
Arterial Blood Pressure	MDC_PRESS_BLD_ART_ABP (2::18964)	Numeric::Compound::FLOAT-Type	MDC_DIM_CM_H2O (4::3904)	
	MDC_PRESS_BLD_ART_ABP_SYS (2::18965)			
	MDC_PRESS_BLD_ART_ABP_DIA (2::18966)			
	MDC_PRESS_BLD_ART_ABP_MEAN (2::18967)			
Wedge Pressure	MDC_PRESS_BLD_ART_PULM_WEDGE (2::18980)	Numeric::FLOAT-Type	MDC_DIM_CM_H2O (4::3904)	

7.3.3 Channel: Blood Pressure – Non-Invasive

Non-invasive blood pressure channels may contain the following parameters:

Table 7.3.3-1: Non-Invasive Blood Pressure Channel Parameters

Non-Invasive Blood Pressure Channel Parameters				
Name	**Term Code**	**Data Type**	**Units**	**Values**
Non-Invasive Blood Pressure	MDC_PRESS_BLD_NONINV (2::18948)	Numeric::Compound::FLOAT-Type	MDC_DIM_CM_H2O (4::3904)	
	MDC_PRESS_BLD_NONINV_SYS (2::18949)			
	MDC_PRESS_BLD_NONINV_DIA (2::18950)			
	MDC_PRESS_BLD_NONINV_MEAN (2::18951)			
Cuff Pressure	MDC_PRESS_CUFF (2::19228)	Numeric::FLOAT-Type	MDC_DIM_CM_H2O (4::3904)	
	MDC_PRESS_CUFF_SYS (2::19229)			
	MDC_PRESS_CUFF_DIA (2::19230)			
	MDC_PRESS_CUFF_MEAN (2::19231)			

7.3.4 Channel: Blood Pressure – Pulse Rate

Pulse rate blood pressure channels may contain the following parameters:

Table 7.3.4-1: Pulse Rate (Blood Pressure) Channel Parameters

Pulse Rate (Blood Pressure) Channel Parameters				
Name	**Term Code**	**Data Type**	**Units**	**Values**
Pulse Rate	MDC_PRESS_RATE (2:: 18442)	Numeric::Compound::FLOAT-Type	MDC_DIM_CM_H2O (4::3904)	

7.3.5 Channel: Temperature

Temperature channels may contain the following parameters:

Table 7.3.5-1: Temperature Channel Parameters

Temperature Channel Parameters				
Name	**Term Code**	**Data Type**	**Units**	**Values**
Body Temp	MDC_TEMP_BODY (2::19292)	Numeric::FLOAT-Type	NOM_DIM_DEGC (4:: 6048)	
Skin Temp	MDC_TEMP_SKIN (2::19316)	Numeric::FLOAT-Type	NOM_DIM_DEGC (4:: 6048)	
Core Temp	MDC_TEMP_CORE (2::19296)	Numeric::FLOAT-Type	NOM_DIM_DEGC (4:: 6048)	

7.3.6 Channel: Pulse Ox

Pulse oximeter channels may contain the following parameters:

Table 7.3.6-1: Pulse Ox Channel Parameters

Pulse Ox Channel Parameters				
Name	**Term Code**	**Data Type**	**Units**	**Values**

7.3.7 Channel: Pulse Rate Ox

Pulse rate oximeter channels may contain the following parameters:

Table 7.3.7-1: Pulse Rate Ox Channel Parameters

Pulse Rate Ox Channel Parameters				
Name	**Term Code**	**Data Type**	**Units**	**Values**

Pulse Rate Ox Channel Parameters				
Name	**Term Code**	**Data Type**	**Units**	**Values**

7.3.8 Channel: ECG Monitoring

ECG monitoring channels may contain the following parameters:

Table 7.3.8-1: ECG Monitoring Channel Parameters

ECG Monitoring Channel Parameters				
Name	**Term Code**	**Data Type**	**Units**	**Values**

7.3.9 Channel: ECG Resp

ECG respiration channels may contain the following parameters:

Table 7.3.9-1: ECG Respiration Channel Parameters

ECG Respiration Channel Parameters				
Name	**Term Code**	**Data Type**	**Units**	**Values**

7.3.10 Channel: Heart Rate

ECG heart rate channels may contain the following parameters:

Table 7.3.10-1: Heart Rate Channel Parameters

Heart Rate Channel Parameters				
Name	**Term Code**	**Data Type**	**Units**	**Values**

7.3.11 Channel: Arrhythmia

ECG arrhythmia channels may contain the following parameters:

Table 7.3.11-1: Arrhythmia Channel Parameters

Arrhythmia Channel Parameters				
Name	**Term Code**	**Data Type**	**Units**	**Values**

7.3.12 Channel: Ischemia

ECG ischemia channels may contain the following parameters:

Table 7.3.12-1: Ischemia Channel Parameters

Ischemia Channel Parameters				
Name	**Term Code**	**Data Type**	**Units**	**Values**

7.3.13 Channel: ECG Measurements

ECG measurement channels may contain the following parameters:

Table 7.3.13-1: ECG Measurements Channel Parameters

ECG Measurements Channel Parameters				
Name	**Term Code**	**Data Type**	**Units**	**Values**

7.3.14 Channel: Cardiac Output – Continuous

Continuous cardiac output channels may contain the following parameters:

Table 7.3.14-1: Continuous Cardiac Output Channel Parameters

Continuous Cardiac Output Channel Parameters				
Name	**Term Code**	**Data Type**	**Units**	**Values**

7.3.15 Channel: Cardiac Output – Intermittent

Intermittent cardiac output channels may contain the following parameters:

Table 7.3.15-1: Intermittent Cardiac Output Channel Parameters

Intermittent Cardiac Output Channel Parameters				
Name	**Term Code**	**Data Type**	**Units**	**Values**

7.3.16 Channel: Hemodynamics Calculator

Hemodynamics calculator channels may contain the following parameters:

Table 7.3.16-1: Hemodynamics Calculator Channel Parameterst

Hemodynamics Calculator Channel Parameters				
Name	**Term Code**	**Data Type**	**Units**	**Values**

Appendices

Appendix A Reserved

***Editor's Note**: Examples of potential Volume 3 appendices include:*

OID assignments specifically for content modules and even term codes

Detailed data type mappings

RTM design specifications

