

- IPMI -

Platform Management FRU Information
Storage Definition

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Revision History

Date	Rev	Modifications
9/16/98	1.0	Initial release.
9/27/99	1.1	Updates to cover errata and clarifications. Added new compatibility MultiRecord types to support distributed power bay applications.
2/28/13	1.2	Updates / errata. Corrected typos. Deleted obsolete reference to 'DMI Vital Product Data'. Added 'ASF' MultiRecord types. Added clarification that input voltage fields in the MultiRecord type 0x00 (power supply input) are signed values, and that FFFh = 'unspecified' for the peak wattage field. Clarified usage of chassis and product info when they're provided in the same FRU device. This was added as footnote 1. Updated document references. Provided clarifications and updated references on character encoding and Strings in the "Type/Length Byte" section and in the Management Access Record (Record Type 0x03). Added "Extended DC Output" and "Extended DC Load" records, per Errata E447, to support larger maximum DC currents. Deleted Table 16 – System Enclosure or Chassis Types and replaced it with a reference to the table from the SMBIOS specification. Added an index for major tables after the Table of Contents.
<u>3/24/15</u>	<u>1.3</u>	<u>Added reserved multi-record values for use by the NVM Express™ working group. See Table 16-2, MultiRecord Area Record Types.</u>

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1. Introduction

This document defines and describes the common format and use of the FRU (Field Replaceable Unit) Information storage in platforms using the Intelligent Platform Management Interface.

The FRU Information is used to primarily to provide ‘inventory’ information about the boards that the FRU Information Device is located on. It is a goal that all major field replaceable units (FRUs) have an EEPROM or FRU Information Device from which, at a minimum, the part number or version number can be read through software. It is also a goal that the FRUs serial number be software readable.

The format divides the FRU Information Device (or EEPROM) into six different areas:

Common Header	The Common Header is mandatory for all FRU Information Device implementations. It holds version information for the overall information format specification and offsets to the other information areas. The other areas may or may not be present based on the application of the device. An area is specified as ‘Null’ or ‘not present’ when the Common Header has a value of 00h for the starting offset for that area.
Internal Use Area	This area provides private, implementation-specific information storage for other devices that exist on the same FRU as the FRU Information Device. The Internal Use Area is usually used to provide private non-volatile storage for a management controller.
Chassis Info Area	This area is used to hold Serial Number, Part Number, and other information about the system chassis. A system can have multiple FRU Information Devices within a chassis, but only one device should provide the Chassis Info Area. Thus, this area will typically be absent from most FRU Information Devices. Ideally this information is in a FRU device that is part of a board that is associated with the chassis, such as a front panel or power distribution board. But many systems, particularly low-end systems, do not incorporate such locations. Therefore, it is common to find the Chassis Info Area included in the FRU information for the baseboard.
Board Info Area	This area provides Serial Number, Part Number, and other information about the board that the FRU Information Device is located on. The name ‘Board Info Area’ is somewhat a misnomer, because the usage is not restricted to just circuit boards. This area is also typically used to provide FRU information for any replaceable entities, boards, or sub-assemblies that are not sold as standalone products separate from other components. For example, individual boards from a board set, or a sub-chassis or backplane that’s part of a larger chassis. ¹
Product Info Area	This area is present if the FRU itself is a separate product. This is typically seen when the FRU is an add-in card, sub-assembly, or a power supply from a separate vendor, etc. When this area is provided in the FRU Information Device

¹ The FRU device that provides info for the chassis is often implemented in the same physical device that provides FRU info for the overall product. In such a case, it is common to have both a product info area and a chassis info area in the device. This device may reside on the motherboard or on a chassis-related board, such as a circuit board for front panel controls. If the overall product and the chassis share the same basic identification information, then it is also common to have duplicate fields between the records. If the chassis is orderable as a separate replacement parts of the overall product, however, then the serial # and part # in the chassis info would typically be different than that for the overall product. Note that because the board info area provides a bit more info than the Chassis Info alone, it is also typical to include a board info area along with the chassis info, though that’s not mandatory.

that contains the Chassis Info Area, the product info is for the overall system, as initially manufactured.

MultiRecord Info Area The MultiRecord Info Area provides a region that holds one or more records where the type and format of the information is specified in the individual headers for the records. This differs from the other information areas, where the type and format of the information are implied by which offset is used in the Common Header. The MultiRecord Info Area provides a mechanism for extending the FRU Information Specification to cover new information types without impacting the existing area definitions.

2. Reference Documents

The following documents are companion and supporting specifications for this document:

- [IPMI_1.0] *Intelligent Platform Management Interface Specification, Version 1.0*, © 1998, 1999 Intel Corporation, Hewlett-Packard Company, NEC Corporation, Dell Computer Corporation.
- [IPMI_1.5] *Intelligent Platform Management Interface Specification, Version 1.5*, © 1999, 2000, 2002, Intel Corporation, Hewlett-Packard Company, NEC Corporation, Dell Computer Corporation
- [IPMI_2.0] *Intelligent Platform Management Interface Specification - Second Generation, v2.0*, © 2009, Intel Corporation, Hewlett-Packard Company, NEC Corporation, Dell Computer Corporation
- [ASF_2.0] *Alert Standard Format (ASF) Specification, Version 2.0*, 23 April 2003, © 2000-2002, Distributed Management Task Force, Inc. (DMTF)
- [SMBIOS] *System Management BIOS (SMBIOS) Reference Specification, Version 2.7.1*, January 26, 2011.
- [UNICODE] *The Unicode Standard, Version 6.2 – Core Specification*, The Unicode Consortium, © 1991–2012 Unicode, Inc.

3. Accessing FRU Inventory Devices

Storage for FRU Inventory Devices can be provided by storage devices that are located directly on the Intelligent Management Bus, or on a 'Private Management Bus'. In this case, the device is typically accessed directly using whatever low-level access interface the device provides.

Because system software needs to know the particular details of how to access the storage device, only a limited number of types of storage devices are supported for direct access. Presently, the supported devices are SEEPROMs that use a '24C02'-compatible interface, and SEEPROMs that are compatible with the Dallas Semiconductor DS1624 Temperature Sensor/SEEPROM interface.

Alternately, a management controller can be used to provide the interface to the FRU Inventory Device. The management controller provides *Read/Write FRU Inventory Data* commands for accessing the non-volatile storage contents via the controller's messaging interface. This is the preferred implementation. The approach provides additional data integrity checking and error handling that are not available when a non-volatile storage device is accessed directly. It also isolates software from the implementation of the non-volatile storage hardware. That is, software uses the same Read/Write FRU Inventory Data commands to the management controller regardless of the type of device used to provide the storage.

During manufacture, initial programming of the devices can be accomplished by other methods, as best suit manufacturing requirements. For example, in some instances a device may be directly accessed by direct connection to its pins via a circuit test fixture.

4. Accessing FRU Inventory Device Data

The Common Header area is the starting point for accessing FRU information data. The Common Header area always starts at offset 00h. The Common Header is present for all FRU Information Devices in the system. The data in this header provides the offsets to the other information areas in the device. A checksum is included to allow the integrity of the header data to be verified.

The Chassis Info, Board Info, and Product Info areas each contain a number of variable length fields. Each of these fields is preceded by a type/length byte that indicates the length of the field and the type of encoding that is used for the field. The leading fields in each area serve predefined functions. These fields can be followed by 'custom' fields that are defined by manufacturing or by the OEM. The same variable length field format is used within records in the MultiRecord Area.

An application that accesses the information starts by verifying that the format version information for the FRU Information Device is a version that the application supports. It does this by extracting the format version information from Common Header area. Next, the application extracts the starting offset for the desired area from the Common Header. The application then accesses the 'header' information specified at the beginning of the area. If the area format version is correct, the application can proceed to access the data. (Note for the MultiRecord area, the Common Header offset points both the start of the area and to the first *Record* in the MultiRecord area.)

Since the fields within an area (or Record) can be variable or fixed length, the application must 'walk' the fields sequentially. The application traverses all fields by walking individual fields until the 'end-of-fields' type/length byte (value C1h) is encountered. (*Note: Only pre-defined fields are allowed to be fixed length without type/length bytes. All custom fields are specified as variable length fields with type/length bytes.*)

Each area/record starts with a fixed number of pre-defined fields. This is followed by a variable number of optional custom fields. If a field is not used, a 'NULL' or 'Empty' version of the field is used as a placeholder. Thus, an application can rely on the Nth field as always having the same meaning. (*Note: this is guaranteed for pre-defined fields only.*)

An application could present predefined fields with labels according to their function and formatted according to the 'type' specified in the type/length field. The application could present custom fields with a generic label (e.g. 'Custom Field 1') followed by the field data formatted according to the 'type' specified in the type/length field (e.g. Hex, ASCII, Binary).

Prior to using any FRU Information Data, applications should validate the checksum for the area or record.

5. More on Predefined and Custom Fields

If an area is present (as indicated by a non-zero offset in the Common Header) the predefined fields for that area must also be present. The predefined fields can be made 'Null', however. This is done by setting the type/length byte to "xx000000" to indicate that the field has no data. All pre-defined fields must be present regardless of whether they are 'Null' or not. Custom fields must always be preceded with a type/length byte. The 'end-of-fields' byte and area checksum are also required.

6. Suggested Storage Organization

The following tables show the *suggested* allocation of storage space. Since the fields are variable lengths, different allocation can be used while still meeting this specification. It is recommended that this distribution be used unless the particular implementation requires field size adjustments (See section on *Changing Area Allocations*, below).

If the Chassis Info Area is not utilized, it is recommended that the Chassis Info Area space either be allocated to the Internal Use Area space, or be left unused. Fields in the board and product info areas are preceded with a type/length byte (with the exception of the version and manufacturing date fields). This indicates how long the field is, and how it is encoded (binary, BCD, 6-bit ASCII, 8-bit ASCII).

Table 6-1, SUGGESTED 2K BIT EEPROM ORGANIZATION

Size	Name	Description
8 bytes	Common Header	Offsets to other areas
72 bytes	Internal Use Area	This area is reserved for management firmware and baseboard use.
32 bytes	Chassis Info Area	Chassis info area. This area holds information about the chassis. This area should be included in only one FRU device in the system, and should be absent from other FRU devices (as indicated by a 0 offset for this area in the common header). If this area is not used, the space may be re-allocated to other areas.
64 bytes	Board Info Area	Board info area (52 available)
80 bytes*	Product Info Area	product info, OEM - customer definable (70 available)

NOTE: The format specifies these areas as variable length. Area sizes may be adjusted to reflect actual space requirements.

* = MINIMUM Recommendation. The goal is to always provide at least 80 bytes for this area when 2K bit or larger EEPROMs are used.

7. Changing Area Allocations

The various areas (other than the Common Header) are specified as variable length regions. If necessary, a FRU Information Device management application can change the allocations from their initial values (assuming that it moves all fields and updates the Common Header and other offsets appropriately).

The main exception to this is that an application should never change the location or size of the Internal Use Area, unless that is explicitly required as part of an update procedure for the device that 'owns' the Internal Use Area.

8. Common Header Format

Table 8-1, COMMON HEADER

field length	field
1*	Common Header Format Version 7:4 - reserved, write as 0000b 3:0 - format version number = 1h for this specification.
1*	Internal Use Area Starting Offset (in multiples of 8 bytes). 00h indicates that this area is not present.
1*	Chassis Info Area Starting Offset (in multiples of 8 bytes). 00h indicates that this area is not present.
1*	Board Area Starting Offset (in multiples of 8 bytes). 00h indicates that this area is not present.
1*	Product Info Area Starting Offset (in multiples of 8 bytes). 00h indicates that this area is not present.
1*	MultiRecord Area Starting Offset (in multiples of 8 bytes). 00h indicates that this area is not present.
1*	PAD, write as 00h
1*	Common Header Checksum (zero checksum)

* = These fields are MANDATORY

9. Internal Use Area Format

Table 9-1, INTERNAL USE AREA (Baseboard Chassis ID definition only)

field length	field
1*	Internal Use Format Version 7:4 - reserved, write as 0000b 3:0 - format version number = 1h for this specification.
xx	Internal use data - defined and formatted as needed for management controller or other device that owns/uses this area.

* = These fields are MANDATORY

10. Chassis Info Area Format

Table 10-1, CHASSIS INFO AREA

field length	field
1	Chassis Info Area Format Version 7:4 - reserved, write as 0000b 3:0 - format version number = 1h for this specification.
1	Chassis Info Area Length (in multiples of 8 bytes)
1	Chassis Type (enumeration) – See Section 14, System Enclosure and Chassis Types.
1	Chassis Part Number type/length
N	Chassis Part Number bytes
1	Chassis Serial Number type/length*
M	Chassis Serial Number bytes*
xx	Custom Chassis Info fields, if any. Each fields must be preceded with type/length byte.
1	C1h (type/length byte encoded to indicate no more info fields).
Y	00h - any remaining unused space
1	Chassis Info Checksum (zero checksum)

* These areas are always encoded as if the Language Code were English.

11. Board Info Area Format

Table 11-1, BOARD INFO AREA

field length	field
1	Board Area Format Version 7:4 - reserved, write as 0000b 3:0 - format version number = 1h for this specification.
1	Board Area Length (in multiples of 8 bytes)
1	Language Code (See section 15)
3	Mfg. Date / Time Number of minutes from 0:00 hrs 1/1/96. LSbyte first (little endian) 00_00_00h = unspecified.
1	Board Manufacturer type/length byte
P	Board Manufacturer bytes
1	Board Product Name type/length byte
Q	Board Product Name bytes
1	Board Serial Number type/length byte*
N	Board Serial Number bytes*
1	Board Part Number type/length byte
M	Board Part Number bytes
1	FRU File ID type/length byte*
R	FRU File ID bytes* The FRU File version field is a pre-defined field provided as a manufacturing aid for verifying the file that was used during manufacture or field update to load the FRU information. The content is manufacturer-specific. This field is also provided in the Product Info area. Either or both fields may be 'null'.
xx	Additional custom Mfg. Info fields. Defined by manufacturing. Each field must be preceded by a type/length byte
1	C1h (type/length byte encoded to indicate no more info fields).
Y	00h - any remaining unused space
1	Board Area Checksum (zero checksum)

* These areas are always encoded as if the Language Code were English.

12. Product Info Area Format

Table 12-1, PRODUCT INFO AREA

field length	field
1	Product Area Format Version 7:4 - reserved, write as 0000b 3:0 - format version number = 1h for this specification
1	Product Area Length (in multiples of 8 bytes)
1	Language Code (See section 15)
1	Manufacturer Name type/length byte
N	Manufacturer Name bytes
1	Product Name type/length byte
M	Product Name bytes
1	Product Part/Model Number type/length byte
O	Product Part/Model Number bytes
1	Product Version type/length byte
R	Product Version bytes
1	Product Serial Number type/length byte*
P	Product Serial Number bytes*
1	Asset Tag type/length byte
Q	Asset Tag
1	FRU File ID type/length byte
R	FRU File ID bytes. The FRU File version field is a pre-defined field provided as a manufacturing aid for verifying the file that was used during manufacture or field update to load the FRU information. The content is manufacturer-specific. This field is also provided in the Board Info area. Either or both fields may be 'null'.
xx	Custom product info area fields, if any (must be preceded with type/length byte)
1	C1h (type/length byte encoded to indicate no more info fields).
Y	00h - any remaining unused space
1	Product Info Area Checksum (zero checksum)

* These fields are always encoded as if the Language Code were English. I.e. if the type/length code bits 7:6=11b the serial number will always be interpreted as 8-bit ASCII+Latin 1, not 16-bit UNICODE.

13. TYPE/LENGTH BYTE FORMAT

The following presents the specification of the type/length byte. **Type/Length encoded field data is always stored most-significant digit/character first.**

7:6 - type code

- 00 - binary or unspecified
- 01 - BCD plus (see below)
- 10 - 6-bit ASCII, packed (overrides Language Codes)
- 11 - Interpretation depends on Language Codes. 11b indicates 8-bit ASCII + Latin 1 (see below) if the Language Code is English for the area or record containing the field, or 2-byte UNICODE (least significant byte first) if the Language Code is not English. At least two bytes of data must be present when this type is used. Therefore, the length (number of data bytes) will always be >1 if data is present, 0 if data is not present.

5:0 - number of data bytes.

000000 indicates that the field is empty. When the type code is 11b, a length of 000001 indicates 'end of fields'. I.e. Type/Length = C1h indicates 'end of fields'.

"**ASCII+LATIN1**" is defined as the *printable* characters from the first set of 256 characters of Unicode 6.2 (U+0000h through U+00FFh, inclusive) expressed as an *eight-bit* value. (Unicode follows ISO/IEC 8859-1 in the layout of printable characters up to U+00FFh).

"**6-bit ASCII**" is the 64 characters starting from character 20h (space) from the ASCII+LATIN1 set. So 6-bit ASCII value 000000b maps to 20h (space), 000001b maps to 21h (!), etc. Packed 6-bit ASCII takes the 6-bit characters and packs them 4 characters to every 3 bytes, with the first character in the least significant 6-bits of the first byte. A table of 6-bit ASCII codes and an example of packed 6-bit ASCII characters is included later in this section.

13.1 BCD PLUS definition:

0h - 9h = digits 0 through 9
 Ah = space
 Bh = dash '-'
 Ch = period '.'
 Dh = reserved
 Eh = reserved
 Fh = reserved

13.2 6-bit ASCII definition

Table 13-1, 6-bit ASCII Definition

0	sp	10	0	20	@	30	P
1	!	11	1	21	A	31	Q
2	"	12	2	22	B	32	R
3	#	13	3	23	C	33	S
4	\$	14	4	24	D	34	T
5	%	15	5	25	E	35	U
6	&	16	6	26	F	36	V
7	'	17	7	27	G	37	W
8	(	18	8	28	H	38	X
9	)	19	9	29	I	39	Y
A	*	1A	:	2A	J	3A	Z
B	+	1B	;	2B	K	3B	[
C	,	1C	<	2C	L	3C	\
D	-	1D	=	2D	M	3D]
E	.	1E	>	2E	N	3E	^
F	/	1F	?	2F	O	3F	_

13.3 6-bit ASCII Packing Example

"IPMI" encoded in 6-bit ASCII is:

I = 29h (101001b)

P = 30h (110000b)

M = 2Dh (101101b)

I = 29h (101001b)

This is packed into bytes as follows:

bit	7	6	5	4	3	2	1	0	hex
byte 1	0	0	1	0	1	0	0	1	29h
byte 2	1	1	0	1	1	1	0	0	DCh
byte 3	1	0	1	0	0	1	1	0	A6h

14. System Enclosure and Chassis Types

The enumeration values for System Enclosure and Chassis Types is defined in the [SMBIOS] specification, Table 16 – System Enclosure or Chassis Types.

15. Language Codes

The following table should be used when interpreting the Language Code fields. The index number (1-136) is stored in the Language Code field. Any language code other than English indicates that the string data is encoded as Unicode when bits 7:6 of the Type/Length code = 11b.

Table 15-1, Language Codes

0.	en	English*			
1.	aa	Afar	51.	it	Italian
2.	ab	Abkhazian	52.	iw	Hebrew
3.	af	Afrikaans	53.	ja	Japanese
4.	am	Amharic	54.	ji	Yiddish
5.	ar	Arabic	55.	jw	Javanese
6.	as	Assamese	56.	ka	Georgian
7.	ay	Aymara	57.	kk	Kazakh
8.	az	Azerbaijani	58.	kl	Greenlandic
9.	ba	Bashkir	59.	km	Cambodian
10.	be	Byelorussian	60.	kn	Kannada
11.	bg	Bulgarian	61.	ko	Korean
12.	bh	Bihari	62.	ks	Kashmiri
13.	bi	Bislama	63.	ku	Kurdish
14.	bn	Bengali; Bangla	64.	ky	Kirghiz
15.	bo	Tibetan	65.	la	Latin
16.	br	Breton	66.	ln	Lingala
17.	ca	Catalan	67.	lo	Laothian
18.	co	Corsican	68.	lt	Lithuanian
19.	cs	Czech	69.	lv	Latvian, Lettish
20.	cy	Welsh	70.	mg	Malagasy
21.	da	danish	71.	mi	Maori
22.	de	german	72.	mk	Macedonian
23.	dz	Bhutani	73.	ml	Malayalam
24.	el	Greek	74.	mn	Mongolian
25.	en	English	75.	mo	Moldavian
26.	eo	Esperanto	76.	mr	Marathi
27.	es	Spanish	77.	ms	Malay
28.	et	Estonian	78.	mt	Maltese
29.	eu	Basque	79.	my	Burmese
30.	fa	Persian	80.	na	Nauru
31.	fi	Finnish	81.	ne	Nepali
32.	fj	Fiji	82.	nl	Dutch
33.	fo	Faeroese	83.	no	Norwegian
34.	fr	French	84.	oc	Occitan
35.	fy	Frisian	85.	om	(Afan) Oromo
36.	ga	Irish	86.	or	Oriya
37.	gd	Scots Gaelic	87.	pa	Punjabi
38.	gl	Galician	88.	pl	Polish
39.	gn	Guarani	89.	ps	Pashto, Pushto
40.	gu	Gujarati	90.	pt	Portuguese
41.	ha	Hausa	91.	qu	Quechua
42.	hi	Hindi	92.	rm	Rhaeto-Romance
43.	hr	Croatian	93.	rn	Kirundi
44.	hu	Hungarian	94.	ro	Romanian
45.	hy	Armenian	95.	ru	Russian
46.	ia	Interlingua	96.	rw	Kinyarwanda
47.	ie	Interlingue	97.	sa	Sanskrit
48.	ik	Inupiak	98.	sd	Sindhi
49.	in	Indonesian	99.	sg	Sangro
50.	is	Icelandic	100.	sh	Serbo-Croatian
			101.	si	Singhalese
			102.	sk	Slovak
			103.	sl	Slovenian
			104.	sm	Samoan
			105.	sn	Shona
			106.	so	Somali
			107.	sq	Albanian
			108.	sr	Serbian
			109.	ss	Siswati
			110.	st	Sesotho
			111.	su	Sudanese
			112.	sv	Swedish
			113.	sw	Swahili
			114.	ta	Tamil
			115.	te	Tegulu
			116.	tg	Tajik
			117.	th	Thai
			118.	ti	Tigrinya
			119.	tk	Turkmen
			120.	tl	Tagalog
			121.	tn	Setswana
			122.	to	Tonga
			123.	tr	Turkish
			124.	ts	Tsonga
			125.	tt	Tatar
			126.	tw	Twi
			127.	uk	Ukrainian
			128.	ur	Urdu
			129.	uz	Uzbek
			130.	vi	Vietnamese
			131.	vo	Volapuk
			132.	wo	Wolof
			133.	xh	Xhosa
			134.	yo	Yoruba
			135.	zh	Chinese
			136.	zu	Zulu

* English is index 0 and 25. Index 0 allows earlier revisions of the FRU format EEPROM to be supported.

16. MultiRecord Area

The MultiRecord Area Starting Offset field in the Common Header points to the start of the first record in the ‘MultiRecord’ area. Each record in this area begins with a pre-defined header as specified in the following table. This header contains a ‘Type’ field that identifies what information is contained in the record.

16.1 Record Header

The Record Header also contains offset information needed to find any additional following records, if any, in a sequential list manner. The Record Header has the following format.

Table 16-1, MultiRecord Area Record Header

field length	field
1	Record Type ID
1	7:7 – End of list 6:4 – Reserved, write as 000b 3:0 – Record Format version (=2h unless otherwise specified)
1	Record Length
1	Record Checksum (zero checksum)
1	Header Checksum (zero checksum)

Any data associated with the header will follow the last field of the header.

16.2 Record Header Fields

16.2.1 Record Type Identification

This unsigned byte is used to identify the information contained in the record. Table 16-2, MultiRecord Area Record Types, lists the currently defined record types and their associated ID values. See section 18, *Record Field Definitions*, for detailed information on the content of the particular record types.

Table 16-2, MultiRecord Area Record Types

ID	Record Type	Section
0x00	Power Supply Information	18.1
0x01	DC Output	18.2
0x02	DC Load	18.3
0x03	Management Access Record	18.4
0x04	Base Compatibility Record	18.5
0x05	Extended Compatibility Record	18.6
0x06	reserved for ASF Fixed SMBus Device record.	[1]
0x07	reserved for ASF Legacy-Device Alerts	[1]
0x08	reserved for ASF Remote Control	[1]
0x09	Extended DC Output	18.2a
0x0A	Extended DC Load	18.3a
<u>0x0B-0x0F</u>	<u>reserved for definition by the NVM Express™ working group.</u>	<u>[2]</u>
<u>0x0E10-0xBF</u>	Reserved	-
0xC0-0xFF	OEM Record Types	18.7

1. See [ASF_2.0] for definition.
2. Refer to specifications from the NVM Express™ working group (www.nvmexpress.org)

16.2.2 End of List

This bit indicates if this record is the last record in the MultiRecord area. If this bit is zero, it indicates that one or more records follow.

16.2.3 Record Format Version

The area version format is stored in the lower nibble of the second byte. This field is used to identify the revision level of information stored in this area. This number will start at zero for each new area. If changes need to be made to the record, e.g. fields added/removed, the version number will be increased to reflect the change.

Unless otherwise specified, the record format version for all record types shall be **02h** for this specification, *including OEM Record Types*. The latter provision is to provide for standardized data fields that precede the OEM specific data within the OEM Record.

16.2.4 Record Length

This unsigned byte indicates the number of bytes of data in the record. This byte can also be used to find the next area in the list. If the “End of List” bit is zero, the length can be added the starting offset of the current Record Data to get the offset of the next Record Header. This field allows for 0 to 255 bytes of data for each record.

16.2.5 Record Checksum

This unsigned byte can be used to calculate a zero checksum for the data area following the header. I.e. the modulo 256 sum of the record data bytes plus the checksum byte equals zero.

16.2.6 Header Checksum

This unsigned byte is used to give the generic header a zero checksum. I.e. the modulo 256 sum of the preceding bytes (starting with the first byte of the header) plus the checksum byte equals zero.

17. FRU Information Layout

The following shows the layout of a FRU Information Device, including the positioning of Records in the MultiRecord area. FRU Information areas always appear in this order. Note that records in the MultiRecord are not required appear in any order based on Record Type.

Table 17-1, FRU Information Layout

Area		Comments
Common Header		Mandatory
Internal Use Area		Optional
Chassis Info Area		Optional
Board Info Area		Optional
Product Info Area		Optional
MultiRecord Area	Record 1	Optional
	Record 2	Optional

	Record X	Optional

The following example shows a FRU Information Device with a MultiRecord Area, but no Internal Use, Chassis Info, Board Info or Product Info areas. There are two records defined in the MultiRecord area.

Table 17-2, FRU Information Layout Example

Area	Offset	Value	Comments
Common Header	0	0	MultiRecord Area Offset
	1	0	
	2	0	
	3	0	
	4	0	
	5	1	
	6	0	
Record 1 Header	7	255	Power Supply Information Record
	8	0	
	9	0	
	10	22	
	11	9	
Record 1 Data	12	225	End of list/Version
	13-25	X	Record length
Record 2 Header	11	9	Record Checksum
	12	225	Header Checksum
	26	1	DC Output
	27	128	End of list/Version
	28	13	Record length
Record 2 Data	29	54	Record Checksum
	30	60	Header Checksum
Record 2 Data	31-43	X	Record 2 Data

18. Record Field Definitions

The following sections describe the fields for the various types of records that may be present in the MultiRecord Area.

18.1 Power Supply Information (Record Type 0x00)

The following table shows the fields in the Power Supply Information Record.

Table 18-1, Power Supply Information (Record Type 0x00)

Offset	Length	Definition
0	2	15:12 – Reserved, write as 0000b 11:0 - Overall capacity (watts) (LSB First)
2	2	Peak VA
4	1	Inrush current
5	1	Inrush interval in ms.
6	2	Low end Input voltage range 1 (10mV, LSB First) (signed)
8	2	High end Input voltage range 1 (10mV, LSB First) (signed)
10	2	Low end Input voltage range 2 (10mV, LSB First , Zero if single range) (signed)
12	2	High end Input voltage range 2 (10mV, LSB First , Zero if single range) (signed)
14	1	Low end Input frequency range
15	1	High end Input frequency range
16	1	Input dropout tolerance in ms
17	1	Binary flags: 7:5 – Reserved, write as 0000b 4:4 – Tachometer pulses per rotation/Predictive fail pin polarity 3:3 – Hot Swap Support 2:2 – Autoswitch 1:1 - Power factor correction 0:0 - Predictive fail support
18	2	Peak Wattage. 15:12 – Hold up time in seconds 11:0 – Peak capacity (watts) (LSB First) [FFFh = unspecified]
20	3	Combined Wattage Byte 1: 7:4 – Voltage 1 3:0 – Voltage 2 Byte 2:3 Total Combined Wattage (LSB First)
23	1	Predictive fail tachometer lower threshold (RPS)

18.1.1 Overall Capacity in Watts

This field allows for Power Supplies with capacities from 0 to 4095 watts.

18.1.2 Peak VA

The highest instantaneous VA value that this supply draws during operation (other than during Inrush). In integer units. FFFFh if not specified.

18.1.3 Inrush

Maximum inrush of current, in Amps, into the power supply. FFh if not specified.

18.1.4 Inrush interval

Number of milliseconds before power supply loading enters non-startup operating range. Set to 0 if no inrush current specified.

18.1.5 Low end Input voltage range 1

This specifies the low end of acceptable voltage into the power supply. The units are 10mV.

18.1.6 High end Input voltage range 1

This specifies the high end of acceptable voltage into the power supply. The units are 10mV.

18.1.7 Low end Input voltage range 2

This specifies the low end of acceptable voltage into the power supply. This field would be used if the power supply did not support autoswitch. Range 1 would define the 110V range, while range 2 would be used for 220V. The units are 10mV.

18.1.8 High end Input voltage range 2

This specifies the high end of acceptable voltage into the power supply. This field would be used if the power supply did not support autoswitch. Range 1 would define the 110V range, while range 2 would be used for 220V. The units are 10mV.

18.1.9 Low end input frequency range

This specifies the low end of acceptable frequency range into the power supply. Use 00h if supply accepts a DC input.

18.1.10 High end input frequency range

This specifies the high end of acceptable frequency range into the power supply. Use 00h for both Low End and High End frequency range if supply only takes a DC input.

18.1.11 Input dropout tolerance

Minimum number of milliseconds the power supply can hold up POWERGOOD (and maintain valid DC output) after input power is lost.

18.1.12 Binary flags**18.1.12.1 Tachometer pulses per rotation/Predictive fail polarity**

The power supply can support predictive fail in two ways. The predictive fail pin could be a pass/fail signal

or the tachometer output of the power supply fan. This field has a dual meaning depending on what the power supply supports. See section 18.1.15 and 18.1.12.2 for more information.

Tachometer predictive fail signal:

- 0 – One pulse per rotation
- 1 – Two pulses per rotation

Pass/fail predictive fail signal:

- 0 – The signal asserted (1) indicates failure
- 1 – The signal de-asserted (0) indicates failure.

18.1.12.2 Other Binary flags

For each of the following binary flags 0=No, 1=Yes.

- Hot Swap supported
- Autoswitch supported
- Power factor correction supported
- Predictive fail pin supported

18.1.13 Peak Wattage

The high 4 bits indicates the number of seconds peak wattage can be sustained (0-15 seconds). The lower 12 bits indicate the peak wattage the power supply can produce during this time period (0-4095 watts).

18.1.14 Combined Wattage

This field indicates the combined maximum wattage of two voltages. A value of 0 for the combined voltage field indicates there are no combined voltages for a power supply. The combined voltage field can contain the following values:

0000b (0)	12V
0001b (1)	-12V
0010b (2)	5V
0011b (3)	3.3V

For example:

0x00 0x00 0x00 – No combined voltages for the power supply

0x23 0x78 0x00 – 5V and 3.3V have a combined wattage of 120 watts.

18.1.15 Predictive fail tachometer lower threshold

This field serves two purposes. It clarifies what type of predictive fail the power supply supports (pass/fail signal or the tachometer output of the power supply fan) and indicates the predictive failing point for tach outputs. This field should be written as zero and ignored if the predictive failure pin of the power supply is not supported.

0x00	Predictive fail pin indicates pass/fail
0x01 – 0xFF	Lower threshold to indicate predictive failure (Rotations per second).

This allows the threshold to be set between 60 and 15300 RPMs. Note the threshold is given in rotations per second. Most fans will output two pulses per rotation. For these fans the pulses will need to be divided by two to determine rotations. See section 18.1.12.1 for more information.

Predictive fail supported	Threshold	Pulses per Rotation / Signal polarity	Notes
0	X	X	Predictive fail not supported
1	0x00	0	Pass/Fail predictive fail pin (1 = fail)
1	0x00	1	Pass/Fail predictive fail pin (0 = fail)
1	0x01-0xFF	0	Tach output, one pulse per rotation
1	0x01-0xFF	1	Tach output, two pulses per rotation

18.2 DC Output (Record Type 0x01)

This record is used to describe the characteristics of a power supply's output voltage. The following table shows the fields in the DC Output Information Record. All two byte values are stored LSB first.

Table 18-2, DC Output (Record Type 0x01)

Offset	Length	Description
0	1	Output information 7:7 – Standby 6:4 – Reserved, write as 000b 3:0 – Output number
1	2	Nominal voltage (10 mV)
3	2	Maximum negative voltage (10 mV) (most negative voltage with respect to nominal)
5	2	Maximum positive voltage (10 mV) (most positive voltage with respect to nominal)
7	2	Ripple and Noise pk-pk 10Hz to 30 MHz (mV)
9	2	Minimum current draw (mA)
11	2	Maximum current draw (mA)

18.2.1 Output Information

Bit 7 indicates if the power supply provides this output even when the power supply is switched off. The lower nibble is used to indicate which output is being specified. A power supply may provide the same current on different outputs. A value of zero indicates the output number is unknown.

18.2.2 Nominal voltage

Expected voltage from the power supply. Value is a signed short given in 10 millivolt increments. The following table gives some example values.

Voltage	Decimal Value	Hex Value
+3.30V	330	0x014A
+12.00V	1200	0x04B0
-12.00V	-1200	0xFB50

18.2.3 Maximum negative voltage

Lowest rated voltage from the power output. Value is a signed short given in 10 millivolt increments.

18.2.4 Maximum positive voltage

Highest rated voltage from the power output. Value is a signed short given in 10 millivolt increments.

18.2.5 Ripple and Noise pk-pk, 10Hz to 30MHz

Value given in mV. Voltage deviation below 10Hz is considered part of the Maximum negative and Maximum Positive voltage deviation specifications.

18.2.6 Minimum current draw

Minimum output capabilities provided for this output. The value is given in milliamps.

18.2.7 Maximum current draw

Maximum output capabilities provided for this output. The value is given in milliamps.

18.2a Extended DC Output (Record Type 0x09)

The format and field definitions of this record are identical to the DC Output (Type 0x01) record except that bit 4 in the Output Information field is used to define the size of the current draw unit. This record can be used to support power supplies with outputs that exceed 65.535 Amps. Refer to the DC Output (Type 0x01) record for additional field descriptions.

Table 18-3, Extended DC Output (Record Type 0x09)

Offset	Length	Description
0	1	Output information 7:7 – Standby 6:5 – Reserved, write as 00b 4 – Current units 0b = 10 mA 1b = 100 mA 3:0 – Output number
1	2	Nominal voltage (10 mV)
3	2	Maximum negative voltage deviation (10 mV) (most negative voltage with respect to nominal)
5	2	Maximum positive voltage deviation (10 mV) (most positive voltage with respect to nominal)
7	2	Ripple and Noise pk-pk 10Hz to 30 MHz (mV)
9	2	Minimum current draw (given in units specified by bit 4 of the Output information field)
11	2	Maximum current draw (given in units specified by bit 4 of the Output information field)

18.3 DC Load (Record Type 0x02)

This record is used to describe the maximum load that a device requires from a particular DC Output. The DC Load records are normally kept on a system board, or a power supply distribution board. The DC Load can be used to see if a power supply, or set of power supplies, can supply appropriate voltage and current for the system. The following table shows the fields in the DC Load Record.

Table 18-4, DC Load (Record Type 0x02)

Offset	Length	Description
0	1	Voltage required 7:4 – Reserved, write as 0000b 3:0 – Output number
1	2	Nominal voltage (10 mV)
3	2	Spec'd minimum voltage (10 mV)
5	2	Spec'd maximum voltage (10 mV)
7	2	Spec'd Ripple and Noise pk-pk 10Hz to 30 MHz (mV)
9	2	Minimum current load (mA)
11	2	Maximum current load (mA)

18.3.1 Output Information

The lower nibble is used to indicate which output is being used. A value of zero indicates unknown output.

18.3.2 Nominal voltage

Expected voltage from the power supply. Value is a signed short given in 10 millivolt increments.

18.3.3 Spec'd minimum voltage

Lowest tolerable voltage from the power supply. Value is a signed short given in 10 millivolt increments.

18.3.4 Spec'd maximum voltage

Highest tolerable voltage from the power supply. Value is a signed short given in 10 millivolt increments.

18.3.5 Ripple and Noise pk-pk 10Hz to 30MHz

Value given in mV.

18.3.6 Minimum current load

Minimum output load needed for this output to maintain specified regulation. The value is given in milliamps.

18.3.7 Maximum current load

Maximum output load needed from this for this output to maintain specified regulation. The value is given in milliamps.

18.3a Extended DC Load (Record Type 0x0A)

The format and field definitions of this record are identical to the DC Load (Type 0x02) record except that bit 4 in the Voltage required field is used to define the size of the current draw unit. This record can be used to support power loads that exceed 65.535 Amps. Refer to the DC Load (Type 0x02) record for additional field descriptions.

Table 18-5, Extended DC Load (Record Type 0x0A)

Offset	Length	Description
0	1	Voltage required 7:5 – Reserved, write as 000b 4 – Current units 0b = 10 mA 1b = 100 mA 3:0 – Output number
1	2	Nominal voltage (10 mV)
3	2	Spec'd minimum voltage (10 mV)
5	2	Spec'd maximum voltage (10 mV)
7	2	Spec'd Ripple and Noise pk-pk 10Hz to 30 MHz (mV)
9	2	Minimum current load (given in units specified by bit 4 of the Voltage required field)
11	2	Maximum current load (given in units specified by bit 4 of the Voltage required field)

18.4 Management Access Record (Record Type 0x03)

The manageable elements of a system may not all be accessible via the same in-band or out-of-band management path. The Management Access Records can be used to hold information that allows software that has access to one system to retrieve information that allows it to get to associated, managed components of the system - and vice-versa. In addition, a system may have more than one management entry point. These records can also be used to determine alternate management access paths as well.

Currently defined Record Types are listed in the table below. All are optional, although the Management URL is expected to be valuable in many system implementations.

Typically, a given FRU device will contain *either* the System information *or* the Component information. The distinction is made for systems with more than one management entry point.

Unless otherwise specified, Strings utilize 8-bit “ASCII+Latin1” encoding (see section 13, TYPE/LENGTH BYTE FORMAT). Strings *are not* required to be NULL terminated by this specification. Software should utilize the Record Length fields to determine the string length. The IPMI specifications do not require implementations to check the validity or restrict the values that are put into String fields. It is the responsibility of the software that stores or initializes the fields to ensure that any requirements imposed by additional specifications, such as IETF RFCs, are met.

Table 18-6, Management Access Record (Record Type 0x03)

ID	Sub-Record Type	Format	Size	Description
0x01	System Management URL	String	16-256	The Internet Uniform Resource Locator string that can be used through a World Wide Web browser to obtain management information about the system that contains this FRU. (e.g. “http://finance.sc.hp.com:280”)

0x02	System Name	String	8-64	A name to identify the system that contains this FRU. (same as DMI "DMTF|General Information|001 - System Name")
0x03	System Ping Address	String	8-64	The IP network address of the system that contains this FRU. Can be either the IP address or the host name + domain name (eg. finance.sc.hp.com).
0x04	Component Management URL	String	16-256	The Internet Uniform Resource Locator string that can be used through a World Wide Web browser to obtain management information about this FRU. (same as DMI "DMTF|Field Replaceable Unit|002 - FRU Internet Uniform Resource Locator")
0x05	Component Name	String	8-256	A clear description of this FRU. (same as DMI "DMTF|Field Replaceable Unit|002 - Description")
0x06	Component Ping Address	String	8-64	The IP network address of this FRU. Can be either the IP address or the host name + domain name (e.g. critter.sc.hp.com).
0x07	System Unique ID	Binary	16	This is a copy of the system GUID from [SMBIOS].

18.4.1 Example

The example below illustrates how the Management URL could be used.

Assume both the Server and the UPS are web-manageable devices with the following management home pages:

Server ("Finance Server 2") – http://finance.sc.hp.com:280
 UPS ("Finance UPS") – http://192.168.0.1

The Server's management pages should include links to attached web-manageable devices such as the UPS. The UPS pages could also include a link back to the Server. ICMB provides a standard interface to the URLs of attached components via the FRU MultiRecord Area. An agent on the Server can then collect all URLs of attached web-manageable devices using IPMI; likewise, the UPS's management processor can determine the Server's URL using ICMB.

Using the data in the MultiRecord Areas (see below), the following HTML tags can be created programmatically:

```
<A HREF= http://finance.sc.hp.com:280>Finance Server 2</A>
<A HREF= http://192.168.0.1>Finance UPS</A>
```

The following tables present examples of records for a system and a UPS.

Example access records for a System:

Table 18-7, Example Management Access Records for a System

field	Contents
Record Type ID	0x03 = Management Access
7:7 – End of list 6:4 – Reserved, write as 000b 3:0 – Record Format version	0x02
Record Length	0x1D
Record Checksum (zero checksum)	[Checksum]
Header Checksum (zero checksum)	[Checksum]
Sub-Record Type	0x01 = System Mgmt. URL
Record [28 bytes]	“http://finance.sc.hp.com:280”
Record Type ID	0x03 = Management Access
7:7 – End of list 6:4 – Reserved, write as 000b 3:0 – Record Format version	0x02
Record Length	0x11
Record Checksum (zero checksum)	[Checksum]
Header Checksum (zero checksum)	[Checksum]
Sub-Record Type	0x02 = System Name
Record [16 bytes]	“Finance Server 2”

Example of records for an associated UPS:

Table 18-8, Example Management Access Records for a UPS

field	Contents
Record Type ID	0x03 = Management Access
7:7 – End of list 6:4 – Reserved, write as 000b 3:0 – Record Format version	0x02
Record Length	0x13
Record Checksum (zero checksum)	[Checksum]
Header Checksum (zero checksum)	[Checksum]
Sub-Record Type	0x01 = System Mgmt. URL
Record [18 bytes]	“http://192.168.0.1”
Record Type ID	0x03 = Management Access
7:7 – End of list 6:4 – Reserved, write as 000b 3:0 – Record Format version	0x82 (note the ‘end-of-list’ bit is only set for the last record in the MultiRecord area)
Record Length	0x0C
Record Checksum (zero checksum)	[Checksum]
Header Checksum (zero checksum)	[Checksum]
Sub-Record Type	0x02 = System Name
Record [11 bytes]	“Finance UPS”

18.5 Base Compatibility Record (Record Type 0x04)

This record was originally defined to provide a mechanism for indicating whether particular power supplies are compatible with one another, but this does not preclude its use for indicating compatibility between other entities. Compatibility is not defined in this specification, but is defined by the manufacturer, standards body, or other group specified by the Manufacturer ID field in the record. The Base Compatibility Record may be accompanied by an Extended Compatibility Record.

The general use of the Base and Extended Compatibility records is as follows. The Base Compatibility Record should typically be used to specify a 'generic' level of compatibility. For example, suppose a defining body 'GroupX' created a specification for interoperability among a class of power supplies. Several different power supply vendors could be required to include a Base Compatibility record with GroupX's Manufacture ID and compatibility codes as a way of indicating conformance to the GroupX specification. A system vendor 'MakerY' may want to have specially branded or approved 'GroupX compatible' supplies. The system vendor could ask the power supply vendor to include an Extended Compatibility Record where the Manufacture ID is set to 'MakerY'. They would then be able to identify the supplies as 'MakerY' qualified 'GroupX' compatible supplies.

The compatibility records enable automated actions to be taken based on whether the records match and to what degree. For example, one system vendor may require that both the Base and Extended records have particular values in order to power up the system, while another may allow any supply that is 'Base' compatible.

Table 18-9, Base Compatibility Record (Record Type 0x04)

Offset	Length	Definition
0	3	Manufacturer ID. 3-byte Manufacturer ID field, as specified in the <i>Get Device ID</i> command in the IPMI v1.0 specification. This field identifies the vendor or group that has defined the specific compatibility meaning for the compatibility codes.
3	1	Entity ID code. This designates the type of entity for which compatibility is being specified. E.g. the Entity ID for a power supply is 10 (decimal). The codes are defined in the <i>Entity ID Codes</i> table in the IPMI v1.0 specification.
4	1	Compatibility base. The party identified by the Manufacturer ID specifies this number. This value will typically be used to identify a base compatibility specification. Entities that do not have matching compatibility base values should be considered incompatible
5	1	Code start. This 7-bit value indicates the starting code for a range of compatible codes within a given compatibility set. 7 reserved. Write a 0b. 6:0 Compatibility code start value. 00h and 7Fh are reserved.
6	1	Code range mask. This field provides a mechanism that can indicate ranges of included or excluded code values, starting from the compatibility code start value. See example in section 18.6.1, below. There is no explicit value that indicates the end of the code mask fields. Software must use the record length to determine the end of the code mask fields. The record can be padded with 00h values if it is desired to make the overall record align to a non-byte boundary. 7 1 = Code start + 8 included 6 1 = Code start + 7 included 5 1 = Code start + 6 included 4 1 = Code start + 5 included 3 1 = Code start + 4 included 2 1 = Code start + 3 included 1 1 = Code start + 2 included 0 1 = Code start + 1 included

Offset	Length	Definition
7:N	-	Additional compatibility code range mask fields. These fields are optional and may not be present. The offsets from the Code Start value pick up where the last code range mask field left off. E.g. bit 0 for byte 7 would correspond to Code Start + 9. 7 1 = last byte

18.6 Extended Compatibility Record (Record Type 0x05)

This record is primarily defined to provide a mechanism for indicating whether particular power supplies are compatible with one another, based on additional criteria beyond what was used for the base compatibility record. The Extended Compatibility Record is optional, but if present will typically be accompanied by a Base Compatibility Record. (Note that having the Extended Compatibility Record accompanied by a Base Compatibility is not mandatory per this specification – but may be mandatory per other specifications).

Note that there should be only one base compatibility record, but there may be multiple extended compatibility records.

Table 18-10, Extended Compatibility Record (Record Type 0x05)

Offset	Length	Definition
0	3	Manufacturer ID. 3-byte Manufacturer ID field, as specified in the <i>Get Device ID</i> command in the IPMI v1.0 specification. This field identifies the vendor or group that has defined the specific compatibility meaning for the compatibility codes.
3	1	Entity ID code. This designates the type of entity for which compatibility is being specified. E.g. the Entity ID for a power supply is 10 (decimal). The codes are defined in the <i>Entity ID Codes</i> table in the IPMI v1.0 specification. This Entity ID code should typically match the value used for Base Compatibility Record.
4	1	Compatibility base. The party identified by the Manufacturer ID specifies this number. This value will typically be used to identify a base compatibility specification. Entities that do not have a matching compatibility base values should be considered incompatible
5	1	Code start. This 7-bit value indicates the starting code for a range of compatible codes within a given compatibility set. 7 reserved. Write a 0b. 6:0 Compatibility code start value. 00h and 7Fh are reserved.
6	1	Code range mask. This field provides a mechanism that can indicate ranges of included or excluded code values, starting from the compatibility code start value. See example in section 18.6.1, below. There is no explicit value that indicates the end of the code mask fields. Software must use the record length to determine the end of the code mask fields. The record can be padded with 00h values if it is desired to make the overall record align to a non-byte boundary. 7 1 = Code start + 8 included 6 1 = Code start + 7 included 5 1 = Code start + 6 included 4 1 = Code start + 5 included 3 1 = Code start + 4 included 2 1 = Code start + 3 included 1 1 = Code start + 2 included 0 1 = Code start + 1 included
7:N	-	Additional compatibility code range mask fields. These fields are optional and may not be present. The offsets from the Code Start value pick up where the last code range mask field left off. E.g. bit 0 for byte 7 would correspond to Code Start + 9.

18.6.1 Code Range Mask Fields Usage Example

The method of encoding the code ranges using bit masks was selected based on the observation that it is unusual for long stretches of functional revisions to occur without compatibility being broken. It is also based on the observation that it is not unusual to discover that all revisions are not equal, and that sometimes a revision is backward compatible with some earlier revisions, but not all. The mechanism also seeks to reduce the storage requirements for the compatibility records.

For this example, assume that the following code values are compatible: 10, 11, 12, 13, 14, 15, 16, 22, and 23. The Code Start value would be set to 10, and the first Code Range Mask would be set to 00111111b which decodes as:

7	0 = Code start (10) + 8	(= code 18) <i>not included</i>
6	0 = Code start (10) + 7	(= code 17) <i>not included</i>
5	1 = Code start (10) + 6	(= code 16) <i>included</i>
4	1 = Code start (10) + 5	(= code 15) <i>included</i>
3	1 = Code start (10) + 4	(= code 14) <i>included</i>
2	1 = Code start (10) + 3	(= code 13) <i>included</i>
1	1 = Code start (10) + 2	(= code 12) <i>included</i>
0	1 = Code start (10) + 1	(= code 11) <i>included</i>

Note that this first byte only takes us up to code 18. A second byte is required to indicate compatibility with codes 22 and 23. This byte is set to 00001000b, which decodes as:

7	0 = Code start (10) + 16	(= code 26) <i>not included</i>
6	0 = Code start (10) + 15	(= code 25) <i>not included</i>
5	0 = Code start (10) + 14	(= code 24) <i>not included</i>
4	1 = Code start (10) + 13	(= code 23) <i>included</i>
3	1 = Code start (10) + 12	(= code 22) <i>included</i>
2	0 = Code start (10) + 11	(= code 21) <i>not included</i>
1	0 = Code start (10) + 10	(= code 20) <i>not included</i>
0	0 = Code start (10) + 9	(= code 19) <i>not included</i>

Thus, we find that using this method, we can encode up to 16 successive revisions using two bytes, while also allowing random revisions among those 16 to be included or excluded from the set of compatible codes.

18.7 OEM Record (Record Types 0xC0-0xFF)

OEM Records have one pre-defined data field: a 3-byte Manufacturer ID field, as specified in the *Get Device ID* command in the IPMI v1.0 specification. This occupies the first 3 bytes of the data portion of the record. Subsequent fields within the record are defined by the given OEM.

Table 18-11, OEM Record (Record Types 0xC0-0xFF)

Offset	Length	Description
0	3	Manufacturer ID. LS Byte first.
1:N	N	OEM data, as specified by the party identified by the Manufacturer ID field.

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