THIS SPECIFICATION IS PROVIDED "AS IS" WITH NO WARRANTIES WHATSOEVER, INCLUDING ANY WARRANTY OF MERCHANTABILITY, NONINFRINGEMENT, FITNESS FOR ANY PARTICULAR PURPOSE, OR ANY WARRANTY OTHERWISE ARISING OUT OF ANY PROPOSAL, SPECIFICATION OR SAMPLE. Without limitation, TCG disclaims all liability, including liability for infringement of any proprietary rights, relating to use of information in this specification and to the implementation of this specification, and TCG disclaims all liability for cost of procurement of substitute goods or services, lost profits, loss of use, loss of data or any incidental, consequential, direct, indirect, or special damages, whether under contract, tort, warranty or otherwise, arising in any way out of use or reliance upon this specification or any information herein.

No license, express or implied, by estoppel or otherwise, to any TCG or TCG member intellectual property rights is granted herein.

Except that a license is hereby granted by TCG to copy and reproduce this specification for internal use only.

Contact the Trusted Computing Group at http://trustedcomputinggroup.org for information on specification licensing through membership agreements.

Any marks and brands contained herein are the property of their respective owners.
# Table of Contents

1. **Introduction** .......................................................................................................................................3  
   1.1 Conventions Used in this Document ..............................................................................................3  
   1.1.1 Data Structure Descriptions ....................................................................................................3  
   1.1.2 Typographic Conventions ........................................................................................................3  
   1.2 External Specifications ...................................................................................................................3  
   1.3 Abbreviations and Terminology ......................................................................................................4  
2. **Implementation Overview** ...................................................................................................................6  
   2.1 EFI ..................................................................................................................................................6  
   2.2 EFI on Top of Conventional BIOS ..................................................................................................7  
   2.3 EFI Layered on Top of SAL ............................................................................................................8  
3. **TCG Protocol** ......................................................................................................................................9  
   3.1 EFI_TCG Protocol ........................................................................................................................10  
   3.1.1 EFI_TCG_PROTOCOL.StatusCheck () ................................................................................11  
   3.1.2 EFI_TCG_PROTOCOL.HashAll () ........................................................................................13  
   3.1.3 EFI_TCG_PROTOCOL.LogEvent () .....................................................................................14  
   3.1.4 EFI_TCG_PROTOCOL.PassThroughToTpm () ....................................................................16  
   3.1.5 EFI_TCG_PROTOCOL.TCGHashLogExtendEvent () ..........................................................17  

**Corrections and Comments**  
Please send comments and corrections to: admin@trustedcomputinggroup.org
1. Introduction

Start of informative comment:
The purpose of this document is to define a standard interface to the TPM on an EFI platform. This standard interface is useful on any of the three example instantiations of an EFI platform shown in Figures 2-1, 2-2, and 2-3, as well as other instantiations. OS loaders and OS manageability agents will use this interface to measure and log the boot process on EFI platforms.

This specification complements the EFI 1.10 Specification.

This TCG EFI Protocol Specification is a pure interface specification that provides no information on “how” to construct the underlying firmware implementation. For that information, see the specifications referenced in Section 1.2, External Specifications.

End of informative comment.

1.1 Conventions Used in this Document

Start of informative comment:
This section gives the data structure description and typographic conventions used in this document.

End of informative comment.

1.1.1 Data Structure Descriptions

All constants and data SHALL be represented as little-endian bit format, which requires the low-order bit on the far left of a constant or data item and the high-order bit on the far right. Exceptions to this, if any, will be explicit in this specification.

All strings SHALL be represented as an array of ASCII bytes with the left-most character placed in the lowest memory location.

In some memory layout descriptions, certain fields are marked reserved. Software must initialize such fields to zero, and ignore them when read. On an update operation, software must preserve any reserved field.

1.1.2 Typographic Conventions

The following typographic conventions are used in this document to illustrate programming concepts:

Prototype This typeface indicates prototype code.
Argument This typeface indicates arguments.
Name This typeface indicates actual code or a programming construct.
Register This typeface indicates a processor register.

1.2 External Specifications

References to external specifications:


1.3 Abbreviations and Terminology

The following abbreviations are used in this specification:

Boot Services
(This definition is copied and pasted from the EFI 1.10 Specification, for the convenience of the reader) The collection of interfaces and protocols that are present in the boot environment. These services minimally provide an OS loader with access to platform capabilities required to complete OS boot. [Boot] services are also available to drivers and applications that need access to platform capability. Boot services terminate once the operating system takes control of the platform.

Boot Services Time
(This definition is copied and pasted from the EFI 1.10 Specification, for the convenience of the reader) The period of time between platform initialization and the call to ExitBootServices(). During this time, EFI drivers and applications are loaded iteratively as the system boots from an ordered list of EFI OS loaders.

CHAR16
The common EFI data type that is a 2-byte character; unless otherwise specified, all strings are stored in the UTF-16 encoding format, as defined by Unicode 2.1 and ISO/IEC 10646 standards. Note: This definition is from Table 2-2 of the Extensible Firmware Specification, version 1.10, December 1, 2002.

EFI Driver
(This definition is copied and pasted from the EFI 1.10 Specification, for the convenience of the reader) A module of code typically inserted into the firmware via protocol interfaces. Drivers may provide device support during the boot process or they may provide platform services. It is important not to confuse an EFI driver with OS drivers that load to provide device support once the OS takes control of the platform.

EFI Hard Disk
(This definition is copied and pasted from the EFI 1.10 Specification, for the convenience of the reader) A hard disk that supports the new EFI partitioning scheme

EFI OS Loader
(This definition is copied and pasted from the EFI 1.10 Specification, for the convenience of the reader) The first piece of operating system code loaded by the firmware to initiate the OS boot process; this code is loaded at a fixed address and then executed. The OS takes control of the system prior to completing the OS boot process by calling the interface that terminates all boot services.

ESP
EFI System Partition: Portion of the hard disk reserved for EFI. It is formatted as FAT12, 16, or 32.
Event Services
The set of functions used to manage EFI events. Includes `CheckEvent()`, `CreateEvent()`, `CloseEvent()`, `SignalEvent()`, and `WaitForEvent()`.

GPT
GUID'd Partition Table: Partitioning scheme that subsumes MBR and uses GUID's and new table definition to describe regions of disk.

GUID
Globally Unique Identifier: A 128-bit value used to differentiate services and structures in the boot services environment.

Image
An executable file stored in a file system that complies with the EFI 1.10 Specification. One type of image is a driver.

Image Handle
(This definition is copied and pasted from the EFI 1.10 Specification, for the convenience of the reader) A handle for loading an image; image handles support the loaded image protocol.

Image Handoff State
(This definition is copied and pasted from the EFI 1.10 Specification, for the convenience of the reader) The information handed off to a loaded image as it begins execution; it consists of the image's handle and a pointer to the image's System Table.

Protocol
EFI Interface: Includes methods and instance data; similar to the public portion of a C++ Class.

System Table
The EFI System Table contains pointers to the active console devices, a pointer to the EFI Boot Services Table, a pointer to the EFI Runtime Services Table, and a pointer to a list of system configuration tables, such as ACPI, SMBIOS, and the SAL System Table. For more information about the EFI System Table, see section 4.1 of the Extensible Firmware Specification, version 1.10, December 1, 2002.

TPM
Trusted Platform Module

Variable
Unicode / GUID pair that is used to index persistent store in EFI.
2. Implementation Overview

Start of informative comment:
There are various embodiments of EFI; this section shows three such embodiments.
End of informative comment.

2.1 EFI

Start of informative comment:
Figure 2-1 shows an EFI Client platform.
The TCG EFI protocol defined in this specification shows as a dark, horizontal line.
End of informative comment.

![Native EFI Platform Diagram]

Figure 2.1 Native EFI Platform
2.2 EFI on Top of Conventional BIOS

Start of informative comment:

Figure 2-2 shows EFI on top of conventional BIOS.

Note that Figure 2-2 shows a series of drivers and a core infrastructure inside the box labeled “EFI Boot Services.” One or more of the series of the Boot Services Drivers may be an EFI 1.10 driver that abstracts and provides an instance of the EFI_TCG Protocol. This specification primarily documents the EFI_TCG Protocol that such a driver uses to communicate with the EFI Boot Services.

For a reference to more information about EFI, see section 1.2, External Specifications.

End of informative comment.

![Diagram of EFI on Top of Conventional BIOS]
2.3 EFI Layered on Top of SAL

Start of informative comment:
Another embodiment of EFI is EFI on top of the System Abstraction Layer (SAL). Figure 2.3, below, shows this layering.
For a reference to more information about SAL, see section 1.2, External References.
End of informative comment.

---

Figure 2.3 EFI Layered on Top of System Abstraction Layer (SAL)
3. TCG Protocol

Start of informative comment:
This section defines the TCG Protocol that abstracts the TCG policy services, the EFI_TCG protocol.

End of informative comment.
3.1 EFI_TCG Protocol

This section provides a detailed description of the EFI_TCG protocol.

**GUID**

```c
#define EFI_TCG_PROTOCOL_GUID   \
        {0xf541796d, 0xa62e, 0x4954, 0xa7, 0x75, 0x95, 0x84, 0xf6, \
         0x1b, 0x9c, 0xdd}
```

**Protocol Interface Structure**

```c
typedef struct {
    EFI_TCG_STATUS_CHECK        StatusCheck;
    EFI_TCG_HASH_ALL           HashAll;
    EFI_TCG_LOG_EVENT          LogEvent;
    EFI_TCG_PASS_THROUGH_TO_TPM  PassThroughToTPM;
    EFI_TCG_HASH_LOG_EXTEND_EVENT HashLogExtendEvent;
} EFI_TCG_PROTOCOL;
```

**Parameters**

- **StatusCheck**: This service provides information on the TPM.
- **HashAll**: This service abstracts the capability to do a hash operation on a data buffer.
- **LogEvent**: This service abstracts the capability to add an entry to the Event Log.
- **PassThroughToTPM**: This service provides a pass-through capability from the caller to the system's TPM.
- **HashLogExtendEvent**: This service abstracts the capability to do a hash operation on a data buffer, extend a specific TPM PCR with the hash result, and add an entry to the Event Log.

**Description**

The EFI_TCG Protocol abstracts TCG activity. This protocol instance provides a Boot Service and is instantiated as a Boot Service Driver.

Boot Service Drivers are terminated when `ExitBootServices()` is called and all memory resources consumed by the Boot Service Drivers are released for use in the operating system environment. The OS must have its own TPM 1.2 driver loaded and ready when `ExitBootServices()` is called. The OS cannot use TPM services that reside in motherboard firmware after `ExitBootServices()` successfully completes.

This Boot Service must create an EVT_SIGNAL_EXIT_BOOT_SERVICES event. This event will be notified by the system when `ExitBootServices()` is invoked.

EVT_SIGNAL_EXIT_BOOT_SERVICES is a synchronous event used to ensure that certain activities occur following a call to a specific interface function; in this case, that is the cleanup that needs to be done in response to the `ExitBootServices()` function. `ExitBootServices()` cannot clean up on behalf of drivers that have been loaded into the system. The drivers have to do that for themselves by creating an event whose type is EVT_SIGNAL_EXIT_BOOT_SERVICES and whose notification function is a function within the driver itself. Then, when `ExitBootServices()` has finished its cleanup, it signals each event type EVT_SIGNAL_EXIT_BOOT_SERVICES.

For implementation details about how a Boot Service instantiated as an EFI Driver creates this required EVT_SIGNAL_EXIT_BOOT_SERVICES event, see Section 5 of the EFI 1.10 Specification.
3.1.1 EFI_TCG_PROTOCOL.StatusCheck ()

Summary
This service provides EFI protocol capability information, state information about the TPM, and Event Log state information.

Prototype
typedef

\texttt{EFI\_STATUS (EFI\_API \*EFI\_TCG\_STATUS\_CHECK) (}
\texttt{IN struct \_EFI\_TCG\_PROTOCOL \*This,}
\texttt{OUT TCG\_BOOT\_SERVICE\_CAPABILITY \*ProtocolCapability,}
\texttt{OUT UINT32 \*TCGFeatureFlags,}
\texttt{OUT EFI\_PHYSICAL\_ADDRESS \*EventLogLocation}
\texttt{OUT EFI\_PHYSICAL\_ADDRESS \*EventLogLastEntry
});

Parameters
\texttt{This}\nIndicates the calling context; see Section 3.1 for the definition of the \texttt{EFI\_TCG\_PROTOCOL} type.

\texttt{ProtocolCapability}\nThe callee allocates memory for a TCG\_BOOT\_SERVICE\_CAPABILITY structure and fills in the fields with the EFI protocol capability information and the current TPM state information.

\texttt{TCGFeatureFlags}\nThis is a pointer to the feature flags. No feature flags are currently defined so this parameter MUST be set to 0. However, in the future, feature flags may be defined that, for example, enable hash algorithm agility.

\texttt{EventLogLocation}\nThis is a pointer to the address of the event log in memory.

\texttt{EventLogLastEntry}\nIf the Event Log contains more than one entry, this is a pointer to the address of the start of the last entry in the event log in memory. For information about what values are returned in this parameter in the special cases of an empty Event Log or an Event Log with only one entry, see the Description section.

Related Definitions
typedef struct {
    UINT8 Major;
    UINT8 Minor;
    UINT8 RevMajor;
    UINT8 RevMinor;
} TCG\_VERSION;

typedef UINT64 EFI\_PHYSICAL\_ADDRESS

typedef struct {
    UINT8 Size;
} //Size of this structure
TCG_VERSION StructureVersion;
TCG_VERSION ProtocolSpecVersion;
UINT8 HashAlgorithmBitmap  //Hash algorithms this
    //protocol is capable of:
    // 01=SHA-1
BOOL TPMPresentFlag          //00h=TPM not present
BOOL TPMDeactivatedFlag;     //01h=TPM currently
    //deactivated
} TCG_EFI_BOOT_SERVICE_CAPABILITY;

Description
The EFI_TCG_PROTOCOL Status Check function call provides EFI protocol capability information,
state information about the TPM, and Event Log state information.

The caller does not use the Status Check function call to verify the presence of the TCG EFI
protocol; on an EFI-capable platform that is done by LocateHandle / Open Protocol.

When the caller invokes the EFI_TCG_PROTOCOL Status Check function, the Event Log may be
empty, may have exactly one entry, or may contain more than one entry.
• If the Event Log is empty, the EventLogLastEntry parameter value MUST be 0 (zero)
• If the Event Log contains exactly one entry, the EventLogLastEntry parameter value MUST
equal the value of the EventLogLocation parameter
• If the EventLog contains more than one entry, the EventLogLastEntry parameter value MUST
be a pointer to the address of the start of the last entry in the event log in memory

Status Codes Returned

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EFI_SUCCESS</td>
<td>Operation completed successfully.</td>
</tr>
<tr>
<td>EFI_DEVICE_ERROR</td>
<td>The command was unsuccessful.</td>
</tr>
<tr>
<td>EFI_INVALID_PARAMETER</td>
<td>One or more of the parameters are incorrect.</td>
</tr>
<tr>
<td>EFI_BUFFER_TOO_SMALL</td>
<td>The receive buffer is too small.</td>
</tr>
<tr>
<td>EFI_NOT_FOUND</td>
<td>The component was not running</td>
</tr>
</tbody>
</table>
3.1.2  EFI_TCG_PROTOCOL.HashAll()

Summary
This service abstracts the capability to do a hash operation on a data buffer.

Prototype
```c
typedef EFI_STATUS (EFIAPI *EFI_TCG_HASH_ALL) (
    IN struct _EFI_TCG_PROTOCOL *This,
    IN UINT8 *HashData,
    IN UINT64 HashDataLen,
    IN TCG_ALGORITHM_ID AlgorithmId,
    IN OUT UINT64 *HashedDataLen,
    IN OUT UINT8 **HashedDataResult
);
```

Parameters
- **This**: Indicates the calling context; see Section 3.1 for the definition of the EFI_TCG_PROTOCOL type.
- **HashData**: Pointer to the data buffer to be hashed
- **HashDataLen**: Length of the data buffer to be hashed
- **AlgorithmId**: Identification of the Algorithm to use for the hashing operation
- **HashedDataLen**: Resultant length of the hashed data
- **HashedDataResult**: Resultant buffer of the hashed data

Related Definitions
```c
typedef UINT32 TCG_ALGORITHM_ID;
#define TCG_ALG_SHA 0x00000004  // The SHA1 algorithm
```

Description
The EFI_TCG_PROTOCOL Hash All Interface function performs the required hash operation on the input data and returns the resulting hash to the caller.

Status Codes Returned
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EFI_SUCCESS</td>
<td>Operation completed successfully.</td>
</tr>
<tr>
<td>EFI_DEVICE_ERROR</td>
<td>The command was unsuccessful.</td>
</tr>
<tr>
<td>EFI_INVALID_PARAMETER</td>
<td>One or more of the parameters are incorrect.</td>
</tr>
<tr>
<td>EFI_BUFFER_TOO_SMALL</td>
<td>The receive buffer is too small.</td>
</tr>
<tr>
<td>EFI_NOT_FOUND</td>
<td>The component was not running.</td>
</tr>
</tbody>
</table>
3.1.3  EFI_TCG_PROTOCOL.LogEvent()

Summary
This service abstracts the capability to add an entry to the Event Log.

Prototype

```c
typedef EFI_STATUS (EFIAPI *EFI_TCG_LOG_EVENT) (  
    IN struct _EFI_TCG_PROTOCOL *This,  
    IN TCG_PCR_EVENT *TCGLogData,  
    IN OUT UINT32 *EventNumber,  
    IN UINT32 Flags
);
```

Parameters

- **This**
  Indicates the calling context; see Section 3.1 for the definition of the **EFI_TCG_PROTOCOL** type.

- **TCGLogData**
  Pointer to the start of the data buffer containing the TCG_PCR_EVENT data structure. All fields in this structure are properly filled by the caller.

- **EventNumber**
  The event number of the event just logged

- **Flags**
  Indicate additional flags. Only one flag has been defined at this time, which is 0x01 and means the extend operation should not be performed. All other bits are reserved.

Related Definitions

```c
#define SHA1_DIGEST_SIZE 20

typedef struct {
    UINT8 Digest[SHA1_DIGEST_SIZE];
} TCG_DIGEST;

typedef TCG_DIGEST TCG_COMPOSITE_HASH;

typedef UINT32 TCG_EVENTTYPE;
```

```c
//
// Log event types
//
#define EV_NO_ACTION 3
#define EV_SEPARATOR 4
#define EV_ACTION 5
#define EV_EVENT_TAG 6
#define EV_CPU_MICROCODE 9
#define EV_PLATFORM_CONFIG_FLAGS 10
#define EV_IPL 13
#define EV_IPL_PARTITION_DATA 14
```
typedef struct {
    TCG_PCRINDEX  PCRIndex; //PCR Index value that either
    //matches the PCRIndex of a
    //previous extend operation or
    //indicates that this Event Log
    //entry is not associated with
    //an extend operation
    TCG_EVENTTYPE  EventType; //See Log event types defined above
    TCG_DIGEST   digest;  //The hash of the event data
    UINT32    EventSize; //Size of the event data
    UINT8     Event[1]; //The event data
} TCG_PCR_EVENT;      //Structure to be added to the
//Event Log

For the definition of the EFI platform-specific event types that are sub-types of the general event type
EV_EVENT_TAG, see section 8.2 of the TCG EFI Platform Specification, version 1.2, available at

Description
This function performs the same operations as EFI_TCG_HASH_LOG_EXTEND_EVENT, except it
does not perform the TPM_Extend operation.

There are two reasons to call the TCGLogEvent function:
(1) To add an informative entry to the Event Log that is not associated with an extend operation to a
PCR. The values within such an entry cannot be verified, but the entry may serve an informative
or delimiting function, as indicated by the EventType. In this case, the caller SHOULD set the
value of the Flags parameter to -1 (all ones) to provide further indication that no extend operation
is to be performed.
(2) To add an entry to the EventLog that is associated with a previous extend operation. The
previous extend operation might have been done in an environment – for example, by the CRTM –
where no memory is available to create the Event Log entry. In this case, the caller MUST set
the value of the PCRIndex parameter to the PCRIndex of the PCR into which the previous extend
operation was done.

Status Codes Returned

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EFI_SUCCESS</td>
<td>Operation completed successfully.</td>
</tr>
<tr>
<td>EFI_DEVICE_ERROR</td>
<td>The command was unsuccessful.</td>
</tr>
<tr>
<td>EFI_INVALID_PARAMETER</td>
<td>One or more of the parameters are incorrect.</td>
</tr>
<tr>
<td>EFI_BUFFER_TOO_SMALL</td>
<td>The receive buffer is too small.</td>
</tr>
<tr>
<td>EFI_NOT_FOUND</td>
<td>The component was not running</td>
</tr>
</tbody>
</table>
3.1.4  EFI_TCG_PROTOCOL.PassThroughToTpm ()

Summary
This service is a proxy for commands to the TPM.

Prototype

typedef
EFI_STATUS
(EFIAPI *EFI_TCG_PASS_THROUGH_TO_TPM) (
    IN struct _EFI_TCG_PROTOCOL *This,
    IN UINT32 TpmInputParameterBlockSize,
    IN UINT8 *TpmInputParameterBlock,
    IN UINT32 TpmOutputParameterBlockSize,
    IN UINT8 *TpmOutputParameterBlock
);

Parameters
This  Indicates the calling context; see Section 3.1 for the definition of the EFI_TCG_PROTOCOL type.

TpmInputParameterBlockSize  Size of the TPM input parameter block
TpmInputParameterBlock  Pointer to the TPM input parameter block
TpmOutputParameterBlockSize  Size of the TPM output parameter block
TpmOutputParameterBlock  Pointer to the TPM output parameter block

Description
The EFI_TCG_PROTOCOL Pass Through to TPM function call provides a pass-through capability from the caller to the system's TPM.

The caller is responsible for building the command byte-stream to be sent to the TPM and is also responsible for interpreting the resulting byte-stream returned by the TPM. The TPM in and out operands for each TPM command are defined in the Main Specification.

Status Codes Returned

<table>
<thead>
<tr>
<th>Status Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EFI_SUCCESS</td>
<td>Operation completed successfully.</td>
</tr>
<tr>
<td>EFI_DEVICE_ERROR</td>
<td>The command was unsuccessful.</td>
</tr>
<tr>
<td>EFI_INVALID_PARAMETER</td>
<td>One or more of the parameters are incorrect.</td>
</tr>
<tr>
<td>EFI_BUFFER_TOO_SMALL</td>
<td>The receive buffer is too small.</td>
</tr>
<tr>
<td>EFI_NOT_FOUND</td>
<td>The component was not running</td>
</tr>
</tbody>
</table>

3.1.5 EFI_TCG_PROTOCOL.TCGHashLogExtendEvent ()

Summary
This service abstracts the capability to do a hash operation on a data buffer, extend a specific TPM PCR with the hash result, and add an entry to the Event Log.

Prototype
typedef
EFI_STATUS
(EIFIAPIT *EFI_TCG_HASH_LOG_EXTEND_EVENT) (
    IN struct _EFI_TCG_PROTOCOL *This,
    IN EFI_PHYSICAL_ADDRESS HashData,
    IN UINT64 HashDataLen,
    IN TCG_ALGORITHM_ID AlgorithmId,
    IN OUT TCG_PCR_EVENT *TCGLogData,
    IN OUT UINT32 *EventNumber
    OUT EFI_PHYSICAL_ADDRESS *EventLogLastEntry);

Parameters
This Indicates the calling context. Type EFI_TCG_PROTOCOL is defined in Section 3.1.
HashData Physical address of the start of the data buffer to be hashed, extended, and logged.
HashDataLen The length, in bytes, of the buffer referenced by HashData
AlgorithmId Identification of the Algorithm to use for the hashing operation
TCGLogData The physical address of the start of the data buffer containing the TCG_PCR_EVENT data structure.
EventNumber The event number of the event just logged.
EventLogLastEntry Physical address of the first byte of the entry just placed in the Event Log. If the Event Log was empty when this function was called then this physical address will be the same as the physical address of the start of the Event Log.

Related Definitions
For the definitions of the event log entry structure and the general event types that use that structure, see section 3.1.3, EFI_TCG_PROTOCOL.LogEvent.

Description
The EFI_TCG_PROTOCOL Hash Log Extend Event function call performs hashing of the event or the event data, extends the event to a PCR, and then places the resulting TCG_PCR_EVENT structure data into the Event Log.

If this function cannot create an Event Log entry (for example, because the Event Log is full), then this function MUST perform the TPM_Extend operation.
If the HashData input parameter is not NULL or the HashDataLen input parameter is not NULL, then this function MUST
1. Treat the data buffer pointed to by the HashData input parameter as a TCG_PCR_EVENT structure, with all fields completed except the TCG_PCR_EVENT.digest field
2. Perform the hash function on the TCG_PCR_EVENT.event field
3. Complete the TCG_PCR_EVENT structure by placing the resulting hash, H1, into the TCG_PCR_EVENT.digest field
4. Perform a TPM_Extend operation, using H1 as the input to the TPM_Extend
5. Place the completed TCG_PCR_EVENT structure into the Event Log
6. Increment the event number value pointed to by the *EventNumber input parameter
7. Place H1 into the data area pointed to by the **HashValue input parameter
8. Return with the appropriate Status Code

If the HashData input parameter is NULL and the HashDataLen input parameter is NULL, then this function MUST
1. Treat the data buffer pointed to by the HashData input parameter as a completed TCG_PCR_EVENT structure, with all fields completed including the TCG_PCR_EVENT.digest field
2. Perform a TPM_Extend operation using the TCG_PCR_EVENT.digest field as input to the TPM_Extend operation
3. Place the TCG_PCR_EVENT structure into the Measurement Log
4. Increment the event number value pointed to by the *EventNumber input parameter
5. Place the TCG_PCR_EVENT.digest field into the data area pointed to by the **HashValue input parameter
6. Return with the appropriate Status Code

### Status Codes Returned

<table>
<thead>
<tr>
<th>Status Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EFI_SUCCESS</td>
<td>Operation completed successfully.</td>
</tr>
<tr>
<td>EFI_DEVICE_ERROR</td>
<td>The command was unsuccessful.</td>
</tr>
<tr>
<td>EFI_INVALID_PARAMETER</td>
<td>One or more of the parameters are incorrect.</td>
</tr>
<tr>
<td>EFI_BUFFER_TOO_SMALL</td>
<td>The receive buffer is too small.</td>
</tr>
<tr>
<td>EFI_NOT_FOUND</td>
<td>The component was not running</td>
</tr>
</tbody>
</table>