Forschungsinstitut

# umati Transformation Engine - API documentation

(Release Candidate, 2021-10-04)

# Chapter 1

# Introduction

The VDW-Forschungsinstitut e.V. is currently working with partners and its members to create a specification of a TransformationEngine.

This documentation describes the interface between the umati Transformation Engine and its Data Clients.

**Application Warning Notice**

This DRAFT with date of issue 2021-10-01 is being submitted to the public for review and comment. Because the final API Specification may differ from this version, the application of this draft is subject to special agreement.

Comments are requested:

- preferably as a file by e-mail to g.goerisch@vdw.de
- or in paper form to VDW-Forschungsinstitut e.V., Lyoner Straße 18, 60528 Frankfurt

## 1.1 Recommended Reading

- Start with Initialization of a data client plugin to get an overview of the relation between transformation engine, shared library, data_client_plugin and data_client.
- Continue with the sections Transformation Engine and Data Client which contain the main components of the interface, namely tek_sa_transformation_engine and tek_sa_data_client.

# Chapter 2

# Initialization of a data client plugin

Each data client shared library represents one plugin. One plugin may be responsible for multiple data client instances of (possibly) different type. Which type of data client is to be created is defined in the configuration. This configuration is passed to a call to tek_sa_data_client_plugin::data_client_new.

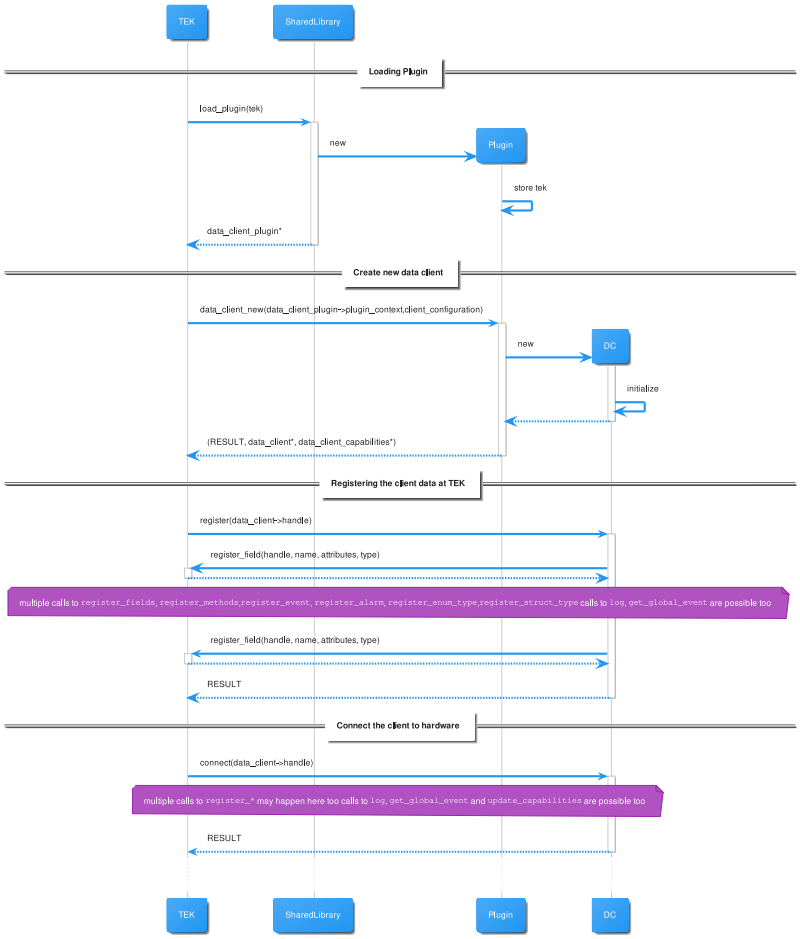
After loading the shared library the TEK calls the main initialization function with the fixed name `load_plugin` and a signature of tek_sa_load_plugin_fn . This function creates a new singleton instance of tek_sa_data_client_plugin and is expected to save the given TEK api struct.

Using the created tek_sa_data_client_plugin, the TEK calls its tek_sa_data_client_plugin::data_client_new method for each configuration.

Each data client then is initialized with calls to tek_sa_data_client::register_features and tek_sa_data_client::connect.

tek_sa_data_client::register_features should do all registration tasks which are possible without a connection to the hardware.

tek_sa_data_client::connect should connect to the hardware and register all new fields, types etc. Additionally it may happen that the capabilities of the data client change after connecting because more information about the hardware are known. Therefore it is expected that a call to tek_sa_transformation_engine::update_capabilities will happen.



# Chapter 3

# Known issues

## 3.1 API definition issues

This sections contains a list of yet unresolved issues concerning the definition of the API which do not relate directly to specific structs or functions.

**Todo** [B, JF] A struct tek_configuration is needed, which contains e.g. the global request timeout value.

**Todo** [D] A possibility to unregister fields, methods, events etc. is needed.

**Todo** [D] A possibility to define the sampling interval of subscribed fields is needed.

**Todo** [A, TEAM] What should be the datatype of the array dimension(s) (int32 or uint32)?

**Todo** [D, TEAM] We need a mechanism to transfer metadata from the controller/DC to the TEK see Teams/↩ Allgemein 15.9.2021

## 3.2 Documentation/Style issues

**Todo** [C, MIG] mkdocs/doxybook2 output can not handle union

**Todo** [C, MIG] mkdocs/doxybook2 output can not handle typedefs

**Todo** [C, MIG] mkdocs/doxybook2 output can not handle function pointers

# Chapter 4

# Todo List

**Page Known issues**

[D] A possibility to unregister fields, methods, events etc. is needed.

[D] A possibility to define the sampling interval of subscribed fields is needed.

[A, TEAM] What should be the datatype of the array dimension(s) (int32 or uint32)?

[D, TEAM] We need a mechanism to transfer metadata from the controller/DC to the TEK see Teams/Allgemein 15.9.2021

[C, MIG] mkdocs/doxybook2 output can not handle union

[C, MIG] mkdocs/doxybook2 output can not handle typedefs

[C, MIG] mkdocs/doxybook2 output can not handle function pointers

[B, JF] A struct tek_configuration is needed, which contains e.g. the global request timeout value.

**Class tek_sa_complex_data_array**

[B, TEAM] should this struct contain the number of bytes in `data` for sanity checks?

**Class tek_sa_complex_data_matrix**

[B, TEAM] should this struct contain the number of bytes in `data` for sanity checks?

**Global tek_sa_data_client::read_fields )(tek_sa_data_client_handle dc, uint64_t request_id, const tek_sa↩ _field_handle items_to_read[], size_t number_of_items, bool do_not_block)**

[B, TEAM] define error values of read function

**Global tek_sa_data_client::subscribe )(tek_sa_data_client_handle dc, const tek_sa_field_handle items_↩ to_subscribe[], size_t number_of_items)**

[D, TEAM] add sampling rate parameter

**Global tek_sa_data_client::write_fields )(tek_sa_data_client_handle dc, uint64_t request_id, const struct tek_sa_field_write_request items_to_write[], size_t number_of_items, bool do_not_block)**

[B, TEAM] should the data client call a progress function if the operation needs more time?

**Class tek_sa_transformation_engine**

[A, TEAM] inconsistent register∗ methods signatures: always return error code or handle

**Global tek_sa_transformation_engine::get_global_event )(const char ∗name)**

[C, TEAM] define the predefined events

[C, TEAM] define return value when event with given name does not exist?

**Global tek_sa_transformation_engine::read_progress )(tek_sa_data_client_handle dc, uint64_t request_id, uint64_t progress)**

[B, TEAM] when should a data client report progress?

[B, TEAM] when can the TEK stop the client (after progress was not reported)?

**Global tek_sa_transformation_engine::set_alarm )(tek_sa_data_client_handle dc, const tek_sa_alarm_↩ handle alarm)**

[C, TEAM] called by data_client after connect, regardless of "acknowledge" calls during previous connection?

# Chapter 5

# Module Index

## 5.1 Modules

Here is a list of all modules:

# Chapter 6

# Data Structure Index

## 6.1 Data Structures

Here are the data structures with brief descriptions:

# Chapter 7

# File Index

## 7.1 File List

Here is a list of all files with brief descriptions:

# Chapter 8

# Module Documentation

## 8.1 Transformation Engine

### Data Structures

- struct tek_sa_transformation_engine

  *Interface ot the Transformation Engine.*

### 8.1.1 Detailed Description

The module **Transformation Engine** contains the main API the transformation engine provides to data clients.

A client can interact the Transformation Engine API by accessing the *api* pointer which is given to the `load_↩ plugin` function. (see the tek_sa_load_plugin_fn description)

Structs and definitions which are used in both the transformation engine and the data client API are described in the section Common Definitions .

## 8.2 Data Client

### Data Structures

- struct tek_sa_data_client_capabilities

  *capabilities of the data client. These capabilities are applied to the complete data client as well as to each instance (device connection). More...*
- struct tek_sa_data_client

  *The interface of one instance of a data client.*
- struct tek_sa_data_client_plugin

  *Interface of the data client plugin.*

## Typedefs

- typedef void * tek_sa_data_client_handle

  *The type of the data client handle.*
- typedef TEK_SA_RESULT(* tek_sa_load_plugin_fn) (struct tek_sa_transformation_engine *api, const struct tek_sa_configuration *plugin_configuration, struct tek_sa_data_client_plugin *plugin)

  *Signature for the load plugin function.*

## Enumerations

- enum tek_sa_threading_model { TEK_SA_THREADING_MODEL_SAME_THREAD = 0x0 , TEK_SA_THREADING_MODEL_S = 0x1 , TEK_SA_THREADING_MODEL_PARALLEL = 0x2 }

  *Describes the threading model of a data client instance of a data client plugin.*

### 8.2.1 Detailed Description

The module **Data Client** contains the API a data client has to implement. Optional parts of the interface are marked accordingly.

Structs and definitions which are used in both the transformation engine and the data client API are described in the section Common Definitions .

### 8.2.2 Data Structure Documentation

#### 8.2.2.1 struct tek_sa_data_client_capabilities

capabilities of the data client. These capabilities are applied to the complete data client as well as to each instance (device connection).

**Remarks**

As these capabilities are extended in the specification process it may be necessary to split the capabilities of the data client and the instance into different structs.

Definition at line 1026 of file south_api.h.

**Data Fields**

| | | |
|---|---|---|
| size_t | number_of_inflight_calls | Number of uncompleted async api calls. Unlimited number of uncompleted calls are signaled using 0 A blocking client uses 1 to signal that the TEK must wait for each result before requesting the next operation.<br><br>**Remarks**<br>This information may be dependent on the physical device and therefore available only after the connection was established. |
| enum tek_sa_threading_model | threading_model | Requirements for the thread calling any communication function in the data client API. |

### 8.2.3 Typedef Documentation

#### 8.2.3.1 tek_sa_data_client_handle

```
typedef void* tek_sa_data_client_handle
```

The type of the data client handle.

An opaque handle for data client plugins. Internal structure of the data_client implementation of a specific plugin is hidden behind this pointer.

Definition at line 233 of file south_api.h.

#### 8.2.3.2 tek_sa_load_plugin_fn

```
typedef TEK_SA_RESULT(* tek_sa_load_plugin_fn) (struct tek_sa_transformation_engine *api, const
struct tek_sa_configuration *plugin_configuration, struct tek_sa_data_client_plugin *plugin)
```

Signature for the load plugin function.

The shared library of the data client will export the function 'load_plugin' that fills a struct data_client_plugin.

**Parameters**

| | |
|---|---|
| *api* | The TEK api. |
| *plugin_configuration* | Additional configuration files, e.g. licensing information, for the plugin itself. |
| *plugin* | The result of the initialized plugin. |

**Returns**

Success or failure code.

Definition at line 1787 of file south_api.h.

### 8.2.4 Enumeration Type Documentation

#### 8.2.4.1 tek_sa_threading_model

```
enum tek_sa_threading_model
```

Describes the threading model of a data client instance of a data client plugin.

**Enumerator**

| | |
|---|---|
| TEK_SA_THREADING_MODEL_SAME_THREAD | The same thread must always be used to call the data client instance. |
| TEK_SA_THREADING_MODEL_SEQUENTIAL | Only one thread of a thread pool is doing a single call at a time at the data client instance. |
| TEK_SA_THREADING_MODEL_PARALLEL | DLL is thread safe, multiple parallel calls are allowed.<br>**Remarks**<br>If the number of parallel tasks in the data client is reached, the API call may return ASYNC_RESULT_RETRY_LATER. |

Definition at line 996 of file south_api.h.

## 8.3 Common Definitions

### Data Structures

- struct tek_sa_additional_file

  *Configuration class which describes an additional file which is passed to the data client. More...*
- struct tek_sa_configuration

  *Configuration object containing the contents of the configuration files for the tek_sa_data_client_plugin or tek_sa_data_client instances. More...*
- struct tek_sa_guid

  *The representation of a GUID when used as a field type. More...*
- struct tek_sa_byte_string

  *The representation of a byte array with variable length when used as a field type. More...*
- struct tek_sa_string

  *The representation of a string with variable length when used as a field type. More...*
- struct tek_sa_complex_data

  *The representation of a field value which has a type which is not a predefined type. More...*
- struct tek_sa_complex_data_array_item

  *The representation of the items of an array of complex data values with exactly one dimension. More...*
- struct tek_sa_complex_data_array

  *The representation of an array of complex data with exactly one dimension. More...*
- struct tek_sa_complex_data_matrix

  *The representation of array of complex data with more than one dimension. More...*
- struct tek_sa_variant_array

  *The representation of a one dimensional array of the supported base types. More...*
- struct tek_sa_variant_matrix

  *The representation of an array with more than one dimension of the supported base types. More...*
- struct tek_sa_variant

  *The representation of a single value (which may be of array type too). More...*
- struct tek_sa_struct_field_type_definition

  *The type definition of a record field in a user defined struct type. More...*
- struct tek_sa_struct_definition

  *The type definition of a user defined record type. More...*
- struct tek_sa_enum_item_definition

*The definition of an enum item which is defined in a user defined enum type. More...*

- struct tek_sa_enum_definition

  *The type definition of a user defined enum type. More...*
- struct tek_sa_method_argument_description

  *The description of a method parameter. More...*
- struct tek_sa_field_write_request

  *Structure to encapsulate the parameters of a write field request. More...*
- struct tek_sa_write_result

  *Structure to encapsulate the result of a write field request. More...*
- struct tek_sa_read_result

  *Structure to encapsulate the result of a read operation of a single field. More...*
- struct tek_sa_event_parameter

  *Structure to encapsulate an event parameter. More...*
- struct tek_sa_dc_event

  *An event which may be sent from the data client to tek_sa_transformation_engine::post_event. More...*
- union tek_sa_variant_array.data

  *The array values. More...*
- union tek_sa_variant.data

  *The value. More...*

## Typedefs

- typedef int64_t tek_sa_type_handle

  *The type of a handle which is returned for user defined types.*
- typedef int64_t tek_sa_type_handle_or_type_enum

  *The type for a reference handle which references either a user defined type (see tek_sa_type_handle) or a predefined type (See tek_sa_variant_type.)*
- typedef int64_t tek_sa_datetime

  *The type of date and time values wen used as a field type.*
- typedef struct tek_sa_variant tek_sa_field_value

  *Type of data client field values.*
- typedef uint32_t tek_sa_field_handle

  *Handle type for a field definition.*
- typedef uint32_t tek_sa_event_handle

  *Handle type for an event definition.*
- typedef uint32_t tek_sa_alarm_handle

  *Handle type for an alarm definition.*
- typedef uint32_t tek_sa_method_handle

  *Handle type for a method definition.*

## Enumerations

- enum tek_sa_variant_type {
  TEK_SA_VARIANT_TYPE_NULL = 0x0 , TEK_SA_VARIANT_TYPE_BOOL = 0x1 , TEK_SA_VARIANT_TYPE_UINT8_T = 0x2 , TEK_SA_VARIANT_TYPE_INT8_T = 0x3 ,
  TEK_SA_VARIANT_TYPE_UINT16_T = 0x4 , TEK_SA_VARIANT_TYPE_INT16_T = 0x5 , TEK_SA_VARIANT_TYPE_UINT32 = 0x6 , TEK_SA_VARIANT_TYPE_INT32_T = 0x7 ,
  TEK_SA_VARIANT_TYPE_UINT64_T = 0x8 , TEK_SA_VARIANT_TYPE_INT64_T = 0x9 , TEK_SA_VARIANT_TYPE_FLOAT = 0xa , TEK_SA_VARIANT_TYPE_DOUBLE = 0xb ,
  TEK_SA_VARIANT_TYPE_DATETIME = 0xc , TEK_SA_VARIANT_TYPE_STRING = 0xd , TEK_SA_VARIANT_TYPE_GUID = 0xe , TEK_SA_VARIANT_TYPE_BYTE_STRING = 0xf ,
  TEK_SA_VARIANT_TYPE_COMPLEX = 0x20 , TEK_SA_VARIANT_TYPE_FLAG_ARRAY = 0x40 ,
  TEK_SA_VARIANT_TYPE_FLAG_MATRIX = 0x80 }

*The predefined types which can be processed in the TE.*

- enum tek_sa_field_attributes { TEK_SA_FIELD_ATTRIBUTES_WRITABLE = 0x1 , TEK_SA_FIELD_ATTRIBUTES_READABLE = 0x2 , TEK_SA_FIELD_ATTRIBUTES_SUBSCRIBABLE = 0x4 }

  *Flags type which contains the attributes of a data client field.*

- enum tek_sa_log_level_t { TEK_SA_LOG_LEVEL_TRACE = 0x0 , TEK_SA_LOG_LEVEL_DEBUG = 0x1 , TEK_SA_LOG_LEVEL_INFO = 0x2 , TEK_SA_LOG_LEVEL_WARNING = 0x3 , TEK_SA_LOG_LEVEL_ERROR = 0x4 , TEK_SA_LOG_LEVEL_CRITICAL = 0x5 }

  *Definition of the possible logging levels which can be used in tek_sa_transformation_engine::log.*

## StatusCodes

- typedef int TEK_SA_RESULT

  *The return value type of all interface functions (which need to return information about success of the operation).*

- #define TEK_SA_ERR_SUCCESS 0

  *An operation was completed successfully.*

- #define TEK_SA_ERR_NON_BLOCKING_IMPOSSIBLE 10

  *A data client function was called in an asynchronous manner while the implementation can not use multiple threads.*

- #define TEK_SA_ERR_OUT_OF_MEMORY 11

  *The data client or the Transformation Engine can not process a request because it has no more system resources.*

- #define TEK_SA_ERR_INVALID_PARAMETER 12

  *The parameters passed to the function are invalid.*

- #define TEK_SA_ERR_RETRY_LATER 0xffffffff

  *A data client function was called in an asynchronous manner while the number of inflight calls is already active.*

- #define TEK_SA_READ_RESULT_STATUS_OK 0

  *A read operation completed successfully.*

- #define TEK_SA_READ_RESULT_STATUS_NOK 1

  *A read operation failed.*

- #define TEK_SA_READ_RESULT_STATUS_TIMEOUT 2

  *A read operation did not complete within the specified time limit.*

- #define TEK_SA_READ_RESULT_STATUS_INVALID_HANDLE 3

  *The read operation failed because the passed field handle was invalid.*

- #define TEK_SA_BLOCK_TRANSFER_END_OF_FILE 26

  *The read operation read until the end of file.*

- #define TEK_SA_BLOCK_TRANSFER_ABORT 24

  *The block read or write operation should be stopped.*

## Handle Constants

- #define TEK_SA_FIELD_HANDLE_INVALID 0

  *An always invalid field handle.*

- #define TEK_SA_EVENT_HANDLE_INVALID 0

  *An always invalid event handle.*

- #define TEK_SA_ALARM_HANDLE_INVALID 0

  *An always invalid alarm handle.*

- #define TEK_SA_METHOD_HANDLE_INVALID 0

  *An always invalid method handle.*

### 8.3.1 Detailed Description

The module **Common Definitions** contains functions, structs and typedefs which are used by the Data Client as well as the Transformation Engine.

### 8.3.2 Data Structure Documentation

#### 8.3.2.1 struct tek_sa_additional_file

Configuration class which describes an additional file which is passed to the data client.

Definition at line 243 of file south_api.h.

**Data Fields**

| | | |
|---|---|---|
| char * | name | The name of the additional file as written in the configuration. |
| char * | content | The content of additional file. |

#### 8.3.2.2 struct tek_sa_configuration

Configuration object containing the contents of the configuration files for the tek_sa_data_client_plugin or tek_sa_data_client instances.

Definition at line 258 of file south_api.h.

**Data Fields**

| | | |
|---|---|---|
| char * | config | The configuration file as UTF-8 encoded JSON string |
| struct tek_sa_additional_file * | additional_files | The additional files which are referenced in the configuration. |
| size_t | additional_files_count | The number of additional files |

#### 8.3.2.3 struct tek_sa_guid

The representation of a GUID when used as a field type.

built-in types (bool, (u)int_{8,16,32,64}_t, strings, guids, datetime; subset of https://reference.↩opcfoundation.org/Core/docs/Part6/5.1.2/

See also https://reference.opcfoundation.org/v104/Core/docs/Part6/5.1.3/

Definition at line 301 of file south_api.h.

**Data Fields**

| | | |
|---|---|---|
| uint32_t | data1 | The `Data1` field. |
| uint16_t | data2 | The `Data2` field. |
| uint16_t | data3 | The `Data3` field. |
| uint8_t | data4[8] | The `Data4` field. |

#### 8.3.2.4 struct tek_sa_byte_string

The representation of a byte array with variable length when used as a field type.

See https://reference.opcfoundation.org/Core/docs/Part6/5.2.2/#5.2.2.7

Definition at line 326 of file south_api.h.

**Data Fields**

| | | |
|---|---|---|
| int32_t | length | The length of the byte string. |
| unsigned char * | data | The bytes of the byte string |

#### 8.3.2.5 struct tek_sa_string

The representation of a string with variable length when used as a field type.

See https://reference.opcfoundation.org/Core/docs/Part6/5.2.2/#5.2.2.4

**Attention**

The string encoding is always UTF-8.

Definition at line 344 of file south_api.h.

**Data Fields**

| | | |
|---|---|---|
| int32_t | length | The length of the byte string. |
| unsigned char * | data | The UTF-8 encoded characters of the string. |

#### 8.3.2.6 struct tek_sa_complex_data

The representation of a field value which has a type which is not a predefined type.

A value with a complex data type which was registered at the tek by calling tek_sa_transformation_engine::register_struct_type.

Definition at line 369 of file south_api.h.

**Data Fields**

| | | |
|---|---|---|
| tek_sa_type_handle | type | The type handle of the registered data type. |
| uint32_t | data_length | The number of bytes in the `data` field.<br>This is needed because the encoded length may differ for items of the same type. |
| unsigned char * | data | The bytes of the serialized value.<br>The serialization is compatible with the binary OPC UA encoding of structures as described in https://reference.↩ opcfoundation.org/v104/Core/docs/Part6/5.2.6/. |

#### 8.3.2.7 struct tek_sa_complex_data_array_item

The representation of the items of an array of complex data values with exactly one dimension.

See also tek_sa_complex_data_array

Definition at line 399 of file south_api.h.

**Data Fields**

| | | |
|---|---|---|
| uint32_t | data_length | The number of bytes in the `data` field.<br>This is needed because the encoded length may differ for items of the same type. |
| unsigned char * | data | The bytes of the serialized value.<br>See also tek_sa_complex_data::data |

#### 8.3.2.8 struct tek_sa_complex_data_array

The representation of an array of complex data with exactly one dimension.

A one-dimensional array of values which are of a complex data type.

**Todo** [B, TEAM] should this struct contain the number of bytes in `data` for sanity checks?

Definition at line 428 of file south_api.h.

**Data Fields**

| | | |
|---|---|---|
| tek_sa_type_handle | type | The type handle of the registered type of the array items. |
| size_t | number_of_items | The number of items in the array. |
| struct tek_sa_complex_data_array_item * | data | The array data, which consists of the concatenation of all serialized items. |

#### 8.3.2.9 struct tek_sa_complex_data_matrix

The representation of array of complex data with more than one dimension.

A multi-dimensional array of values which are of a complex data type.

**Todo** [B, TEAM] should this struct contain the number of bytes in `data` for sanity checks?

Definition at line 453 of file south_api.h.

**Data Fields**

| | | |
|---|---|---|
| tek_sa_type_handle | type | The type handle of the registered type of the array items. |
| int32_t | dimension_length | The number of dimensions in the array. |
| int32_t * | dimensions | The array dimensions.<br>Multi-dimensional arrays are encoded as a one-dimensional array and this field specifies the dimensions of the array. The original array can be reconstructed using this information. Higher rank dimensions are serialized first. For example, an array with dimensions [2,2,2] is written in this order: [0,0,0], [0,0,1], [0,1,0], [0,1,1], [1,0,0], [1,0,1], [1,1,0], [1,1,1]<br>This is compatible with the encoding used by OPC UA array types: https://reference.opcfoundation.org/v104/Core/docs/Part6/5.2.2/#5.2.2.16 |
| struct tek_sa_complex_data_array_item * | data | The array data, which consists of the concatenation of all serialized items. |

#### 8.3.2.10 struct tek_sa_variant_array

The representation of a one dimensional array of the supported base types.

Definition at line 556 of file south_api.h.

**Data Fields**

| | | |
|---|---|---|
| int32_t | length | The number of elements in the array. |
| union tek_sa_variant_array.data | data | The array values. |

#### 8.3.2.11 struct tek_sa_variant_matrix

The representation of an array with more than one dimension of the supported base types.

Definition at line 584 of file south_api.h.

**Data Fields**

| | | |
|---|---|---|
| int32_t | dimension_length | The number of array dimensions. |

**Data Fields**

| | | |
|---|---|---|
| int32_t * | dimensions | The array dimensions.<br>Multi-dimensional arrays are encoded as a one-dimensional array and this field specifies the dimensions of the array. The original array can be reconstructed using this information. Higher rank dimensions are serialized first. For example, an array with dimensions [2,2,2] is written in this order: [0,0,0], [0,0,1], [0,1,0], [0,1,1], [1,0,0], [1,0,1], [1,1,0], [1,1,1]<br>This is compatible with the encoding used by OPC UA array types: https://reference.opcfoundation.org/v104/Core/docs/Part6/5.2.2/#5.2.2.16 |
| struct tek_sa_variant_array | data | The array values. |

#### 8.3.2.12 struct tek_sa_variant

The representation of a single value (which may be of array type too).

Definition at line 611 of file south_api.h.

**Data Fields**

| | | |
|---|---|---|
| uint8_t | type | The type of the value.<br>Must be one of the values described in tek_sa_variant_type. |
| union tek_sa_variant.data | data | The value. |

#### 8.3.2.13 struct tek_sa_struct_field_type_definition

The type definition of a record field in a user defined struct type.

Definition at line 656 of file south_api.h.

**Data Fields**

| | | |
|---|---|---|
| char * | name | The name of the data field. |
| tek_sa_type_handle_or_type_enum | type | The type of the field, represented as type_handle or type enum. |

#### 8.3.2.14 struct tek_sa_struct_definition

The type definition of a user defined record type.

Definition at line 669 of file south_api.h.

**Data Fields**

| | | |
|---|---|---|
| char * | name | The name of the type. |
| struct tek_sa_struct_field_type_definition * | items | The definition of the record fields. |
| size_t | item_count | The number of fields in the record type. |

#### 8.3.2.15 struct tek_sa_enum_item_definition

The definition of an enum item which is defined in a user defined enum type.

Definition at line 687 of file south_api.h.

**Data Fields**

| | | |
|---|---|---|
| char * | name | The name of the enum item. |
| int32_t | value | The numeric value of the enum item. |

#### 8.3.2.16 struct tek_sa_enum_definition

The type definition of a user defined enum type.

Definition at line 700 of file south_api.h.

**Data Fields**

| | | |
|---|---|---|
| char * | name | The name of the type. |
| struct tek_sa_enum_item_definition * | items | The defined enum values of this type. |
| size_t | item_count | The number of defined enum values. |

#### 8.3.2.17 struct tek_sa_method_argument_description

The description of a method parameter.

See tek_sa_transformation_engine::register_method

Definition at line 719 of file south_api.h.

**Data Fields**

| | | |
|---|---|---|
| char const * | name | The name of the method parameter. |
| enum tek_sa_variant_type | type | The type of the method parameter. |

#### 8.3.2.18 struct tek_sa_field_write_request

Structure to encapsulate the parameters of a write field request.

Definition at line 859 of file south_api.h.

**Data Fields**

| | | |
|---|---|---|
| tek_sa_field_handle | handle | The field handle as returned from tek_sa_transformation_engine::register_field. |
| tek_sa_field_value | value | The value to be written to the field. |

#### 8.3.2.19 struct tek_sa_write_result

Structure to encapsulate the result of a write field request.

Definition at line 871 of file south_api.h.

**Data Fields**

| | | |
|---|---|---|
| TEK_SA_RESULT | status | The write operation result. |
| tek_sa_field_handle | handle | The handle of the field written. |

#### 8.3.2.20 struct tek_sa_read_result

Structure to encapsulate the result of a read operation of a single field.

Definition at line 883 of file south_api.h.

**Data Fields**

| | | |
|---|---|---|
| TEK_SA_RESULT | status | The read operation result. |
| tek_sa_field_handle | handle | The handle of the read field. |
| tek_sa_field_value | value | The read value.<br><br>**Attention**<br>Must not be accessed if the `status` is not TEK_SA_ERR_SUCCESS |

#### 8.3.2.21 struct tek_sa_event_parameter

Structure to encapsulate an event parameter.

Definition at line 903 of file south_api.h.

**Data Fields**

| | | |
|---|---|---|
| char const * | name | The name of the parameter. |
| tek_sa_field_value | value | The value of the event parameter. |

#### 8.3.2.22 struct tek_sa_dc_event

An event which may be sent from the data client to tek_sa_transformation_engine::post_event.

Definition at line 915 of file south_api.h.

**Data Fields**

| | | |
|---|---|---|
| tek_sa_datetime | timestamp | The Timestamp of the event.<br><br>**Remarks**<br>This should be the a value as close as possible to the actual occurrence of the event. |
| int16_t | severity | The severity level of the event.<br>The severity is defined as in https://reference.opcfoundation.org/v104/Core/docs/Part5/6.4.2/ which is cited here:<br>Severity is an indication of the urgency of the Event. This is also commonly called “priority”. Values will range from 1 to 1 000, with 1 being the lowest severity and 1 000 being the highest. Typically, a severity of 1 would indicate an Event which is informational in nature, while a value of 1 000 would indicate an Event of catastrophic nature, which could potentially result in severe financial loss or loss of life. |
| tek_sa_event_handle | event_type | The event type handle as returned by the call to tek_sa_transformation_engine::register_event.<br><br>**Attention**<br>This field must not be TEK_SA_EVENT_HANDLE_INVALID |
| tek_sa_field_handle | source | The handle of the source of the event.<br>The source of the event is a field in the data client. As not all events have a source, this field may be equal to TEK_SA_FIELD_HANDLE_INVALID. |
| size_t | number_of_parameters | The number of event parameters. |
| struct tek_sa_event_parameter * | parameters | The event parameters. |

#### 8.3.2.23 union tek_sa_variant_array.data

The array values.

Definition at line 561 of file south_api.h.

**Data Fields**

| | | |
|---|---|---|
| bool * | b | |
| uint8_t * | ui8 | |
| int8_t * | i8 | |
| uint16_t * | ui16 | |
| int16_t * | i16 | |
| uint32_t * | ui32 | |
| int32_t * | i32 | |

**Data Fields**

| | | |
|---|---|---|
| uint64_t * | ui64 | |
| int64_t * | i64 | |
| float * | f | |
| double * | d | |
| tek_sa_datetime * | dt | |
| struct tek_sa_string * | s | |
| struct tek_sa_guid * | guid | |
| struct tek_sa_byte_string * | bs | |

#### 8.3.2.24 union tek_sa_variant.data

The value.

Definition at line 620 of file south_api.h.

**Data Fields**

| | | |
|---|---|---|
| bool | b | |
| uint8_t | ui8 | |
| int8_t | i8 | |
| uint16_t | ui16 | |
| int16_t | i16 | |
| uint32_t | ui32 | |
| int32_t | i32 | |
| uint64_t | ui64 | |
| int64_t | i64 | |
| float | f | |
| double | d | |
| tek_sa_datetime | dt | |
| struct tek_sa_string | s | |
| struct tek_sa_guid | guid | |
| struct tek_sa_byte_string | bs | |
| struct tek_sa_variant_array | array | |
| struct tek_sa_variant_matrix | matrix | |
| struct tek_sa_complex_data | complex | |
| struct tek_sa_complex_data_array | complex_array | |
| struct tek_sa_complex_data_matrix | complex_matrix | |

### 8.3.3 Macro Definition Documentation

#### 8.3.3.1 TEK_SA_FIELD_HANDLE_INVALID

```
#define TEK_SA_FIELD_HANDLE_INVALID 0
```

An always invalid field handle.

Definition at line 762 of file south_api.h.

#### 8.3.3.2 TEK_SA_EVENT_HANDLE_INVALID

```
#define TEK_SA_EVENT_HANDLE_INVALID 0
```

An always invalid event handle.

Definition at line 765 of file south_api.h.

#### 8.3.3.3 TEK_SA_ALARM_HANDLE_INVALID

```
#define TEK_SA_ALARM_HANDLE_INVALID 0
```

An always invalid alarm handle.

Definition at line 768 of file south_api.h.

#### 8.3.3.4 TEK_SA_METHOD_HANDLE_INVALID

```
#define TEK_SA_METHOD_HANDLE_INVALID 0
```

An always invalid method handle.

Definition at line 771 of file south_api.h.

#### 8.3.3.5 TEK_SA_ERR_SUCCESS

```
#define TEK_SA_ERR_SUCCESS 0
```

An operation was completed successfully.

Definition at line 789 of file south_api.h.

#### 8.3.3.6 TEK_SA_ERR_NON_BLOCKING_IMPOSSIBLE

```
#define TEK_SA_ERR_NON_BLOCKING_IMPOSSIBLE 10
```

A data client function was called in an asynchronous manner while the implementation can not use multiple threads.

The TEK will call the function in a synchronous manner again.

See Asynchronous Data Client calls and tek_sa_data_client_capabilities

Definition at line 800 of file south_api.h.

#### 8.3.3.7 TEK_SA_ERR_OUT_OF_MEMORY

```
#define TEK_SA_ERR_OUT_OF_MEMORY 11
```

The data client or the Transformation Engine can not process a request because it has no more system resources.

Definition at line 806 of file south_api.h.

#### 8.3.3.8 TEK_SA_ERR_INVALID_PARAMETER

```
#define TEK_SA_ERR_INVALID_PARAMETER 12
```

The parameters passed to the function are invalid.

Definition at line 809 of file south_api.h.

#### 8.3.3.9 TEK_SA_ERR_RETRY_LATER

```
#define TEK_SA_ERR_RETRY_LATER 0xffffffff
```

A data client function was called in an asynchronous manner while the number of inflight calls is already active.

The TEK will call the function again at a later time.

See Asynchronous Data Client calls and tek_sa_data_client_capabilities

Definition at line 821 of file south_api.h.

#### 8.3.3.10 TEK_SA_READ_RESULT_STATUS_OK

```
#define TEK_SA_READ_RESULT_STATUS_OK 0
```

A read operation completed successfully.

Definition at line 824 of file south_api.h.

#### 8.3.3.11 TEK_SA_READ_RESULT_STATUS_NOK

```
#define TEK_SA_READ_RESULT_STATUS_NOK 1
```

A read operation failed.

Definition at line 827 of file south_api.h.

#### 8.3.3.12 TEK_SA_READ_RESULT_STATUS_TIMEOUT

```
#define TEK_SA_READ_RESULT_STATUS_TIMEOUT 2
```

A read operation did not complete within the specified time limit.

Definition at line 830 of file south_api.h.

#### 8.3.3.13 TEK_SA_READ_RESULT_STATUS_INVALID_HANDLE

```
#define TEK_SA_READ_RESULT_STATUS_INVALID_HANDLE 3
```

The read operation failed because the passed field handle was invalid.

Definition at line 834 of file south_api.h.

#### 8.3.3.14 TEK_SA_BLOCK_TRANSFER_END_OF_FILE

```
#define TEK_SA_BLOCK_TRANSFER_END_OF_FILE 26
```

The read operation read until the end of file.

This result value applies to the tek_sa_transformation_engine::block_read_data callback.

Definition at line 842 of file south_api.h.

#### 8.3.3.15 TEK_SA_BLOCK_TRANSFER_ABORT

```
#define TEK_SA_BLOCK_TRANSFER_ABORT 24
```

The block read or write operation should be stopped.

This result value applies to the tek_sa_transformation_engine::block_read_data and the tek_sa_transformation_engine::block_write_d callback.

Definition at line 851 of file south_api.h.

### 8.3.4 Typedef Documentation

#### 8.3.4.1 tek_sa_type_handle

```
typedef int64_t tek_sa_type_handle
```

The type of a handle which is returned for user defined types.

The TEK creates a unique type handle for every type registered with a call to tek_sa_transformation_engine::register_struct_type or tek_sa_transformation_engine::register_enum_type. The TEK also ensures that the value range of these handles does not overlap with tek_sa_variant_type.

Definition at line 285 of file south_api.h.

#### 8.3.4.2 tek_sa_type_handle_or_type_enum

```
typedef int64_t tek_sa_type_handle_or_type_enum
```

The type for a reference handle which references either a user defined type (see tek_sa_type_handle) or a predefined type (See tek_sa_variant_type.)

Definition at line 291 of file south_api.h.

#### 8.3.4.3 tek_sa_datetime

```
typedef int64_t tek_sa_datetime
```

The type of date and time values wen used as a field type.

The definition is based on OPC UA DateTime (see https://reference.opcfoundation.org/↩ Core/docs/Part6/5.2.2/#5.2.2.5)

Definition at line 360 of file south_api.h.

#### 8.3.4.4 tek_sa_field_value

```
typedef struct tek_sa_variant tek_sa_field_value
```

Type of data client field values.

Definition at line 647 of file south_api.h.

#### 8.3.4.5 tek_sa_field_handle

```
typedef uint32_t tek_sa_field_handle
```

Handle type for a field definition.

Definition at line 746 of file south_api.h.

#### 8.3.4.6 tek_sa_event_handle

```
typedef uint32_t tek_sa_event_handle
```

Handle type for an event definition.

Definition at line 749 of file south_api.h.

#### 8.3.4.7 tek_sa_alarm_handle

```
typedef uint32_t tek_sa_alarm_handle
```

Handle type for an alarm definition.

Definition at line 752 of file south_api.h.

#### 8.3.4.8 tek_sa_method_handle

```
typedef uint32_t tek_sa_method_handle
```

Handle type for a method definition.

Definition at line 755 of file south_api.h.

#### 8.3.4.9 TEK_SA_RESULT

```
typedef int TEK_SA_RESULT
```

The return value type of all interface functions (which need to return information about success of the operation).

Definition at line 786 of file south_api.h.

### 8.3.5 Enumeration Type Documentation

#### 8.3.5.1 tek_sa_variant_type

```
enum tek_sa_variant_type
```

The predefined types which can be processed in the TE.

This enum type is a composition of enum and flag values. Each enum value (the ones *not* starting with "TEK_SA↩ _VARIANT_TYPE_FLAG") may be combined with zero or one flags (the ones starting with "TEK_SA_VARIANT_↩ TYPE_FLAG").

**Enumerator**

| | |
|---|---|
| TEK_SA_VARIANT_TYPE_NULL | The invalid type id. |
| TEK_SA_VARIANT_TYPE_BOOL | The type id of a bool value. |
| TEK_SA_VARIANT_TYPE_UINT8_T | The type id of an unsigned byte value. |
| TEK_SA_VARIANT_TYPE_INT8_T | The type id of a signed byte value. |
| TEK_SA_VARIANT_TYPE_UINT16_T | The type id of an unsigned short value. |
| TEK_SA_VARIANT_TYPE_INT16_T | The type id of a signed short value. |
| TEK_SA_VARIANT_TYPE_UINT32_T | The type id of an unsigned 32bit integer value. |
| TEK_SA_VARIANT_TYPE_INT32_T | The type id of a signed 32bit integer value value. |
| TEK_SA_VARIANT_TYPE_UINT64_T | The type id of an unsigned 64bit integer value. |
| TEK_SA_VARIANT_TYPE_INT64_T | The type id of a signed 64bit integer value. |
| TEK_SA_VARIANT_TYPE_FLOAT | The type id of a 32bit floating point value. |
| TEK_SA_VARIANT_TYPE_DOUBLE | The type id of a 64bit floating point value. |
| TEK_SA_VARIANT_TYPE_DATETIME | The type id of a date and time value. See tek_sa_datetime. |
| TEK_SA_VARIANT_TYPE_STRING | The type id of a string value. See tek_sa_string. |
| TEK_SA_VARIANT_TYPE_GUID | The type id of a GUID value. See tek_sa_guid. |
| TEK_SA_VARIANT_TYPE_BYTE_STRING | The type id of a byte string value. See tek_sa_byte_string. |
| TEK_SA_VARIANT_TYPE_COMPLEX | The type id of a value with a complex data type. See tek_sa_transformation_engine::register_struct_type. |
| TEK_SA_VARIANT_TYPE_FLAG_ARRAY | The flag which is set to declare an array with one dimension of the base type. |
| TEK_SA_VARIANT_TYPE_FLAG_MATRIX | The flag which is set to declare an array with more than one dimension of the base type. |

Definition at line 492 of file south_api.h.

#### 8.3.5.2 tek_sa_field_attributes

`enum tek_sa_field_attributes`

Flags type which contains the attributes of a data client field.

**Enumerator**

| | |
|---|---|
| TEK_SA_FIELD_ATTRIBUTES_WRITABLE | The attribute to mark a field as writeable. |
| TEK_SA_FIELD_ATTRIBUTES_READABLE | The attribute to mark a field as readable. |
| TEK_SA_FIELD_ATTRIBUTES_SUBSCRIBABLE | The attribute to mark a field which can be subscribed to. |

Definition at line 734 of file south_api.h.

#### 8.3.5.3 tek_sa_log_level_t

`enum tek_sa_log_level_t`

Definition of the possible logging levels which can be used in tek_sa_transformation_engine::log.

**Enumerator**

| | |
|---|---|
| TEK_SA_LOG_LEVEL_TRACE | |
| TEK_SA_LOG_LEVEL_DEBUG | |
| TEK_SA_LOG_LEVEL_INFO | |
| TEK_SA_LOG_LEVEL_WARNING | |
| TEK_SA_LOG_LEVEL_ERROR | |
| TEK_SA_LOG_LEVEL_CRITICAL | |

Definition at line 973 of file south_api.h.

# Chapter 9

# Data Structure Documentation

## 9.1 tek_sa_data_client Struct Reference

The interface of one instance of a data client.

`#include <south_api.h>`

### Data Fields

#### Lifecycle functions

- TEK_SA_RESULT(∗ register_features )(tek_sa_data_client_handle dc)
  *Register all known features of the data client.*
- TEK_SA_RESULT(∗ connect )(tek_sa_data_client_handle dc)
  *Connect the data client to the data source.*
- void(∗ free )(tek_sa_data_client_handle dc)
  *Frees the data client and releases all its resources.*

#### Data client functions

- TEK_SA_RESULT(∗ read_fields )(tek_sa_data_client_handle dc, uint64_t request_id, const tek_sa_field_handle items_to_read[ ], size_t number_of_items, bool do_not_block)
  *Function to read one or more fields from the data client. The call may be executed in a synchronous or asynchronous manner (See parameter `do_not_block`).*
- TEK_SA_RESULT(∗ write_fields )(tek_sa_data_client_handle dc, uint64_t request_id, const struct tek_sa_field_write_request items_to_write[ ], size_t number_of_items, bool do_not_block)
  *Function to write values to data client fields.*
- TEK_SA_RESULT(∗ block_read )(const tek_sa_data_client_handle dc, uint64_t request_id, const char ∗filepath, uint64_t offset, int64_t length, bool do_not_block, int64_t ∗filesize)
  *Starts a block transfer from the client to the TEK.*
- TEK_SA_RESULT(∗ block_write )(const tek_sa_data_client_handle dc, uint64_t request_id, const char ∗filepath, uint64_t offset, int64_t length, bool do_not_block)
  *Start a block transfer from the TEK to the data client.*
- TEK_SA_RESULT(∗ subscribe )(tek_sa_data_client_handle dc, const tek_sa_field_handle items_to_↩ subscribe[ ], size_t number_of_items)
  *Subscribe to changes of one ore more data client fields.*
- TEK_SA_RESULT(∗ unsubscribe )(tek_sa_data_client_handle dc, const tek_sa_field_handle items_to_↩ unsubscribe[ ], size_t number_of_items)
  *Unsubscribe to changes of one ore more data client fields.*

- TEK_SA_RESULT(∗ invoke )(const tek_sa_data_client_handle dc, const tek_sa_method_handle method, uint64_t request_id, const tek_sa_field_value parameters[ ], const size_t number_of_parameters)
  *Invoke a method on the data client.*
- void(∗ acknowledge_alarm )(tek_sa_data_client_handle dc, const tek_sa_alarm_handle alarm)
  *Acknowledge an alarm in the data client.*

**Data fields**

- tek_sa_data_client_handle handle
  *The handle that is passed as first parameter in all functions of this interface.*

## 9.1.1 Detailed Description

The interface of one instance of a data client.

Definition at line 1052 of file south_api.h.

## 9.1.2 Field Documentation

### 9.1.2.1 register_features

```
TEK_SA_RESULT(* tek_sa_data_client::register_features) (tek_sa_data_client_handle dc)
```

Register all known features of the data client.

**Parameters**

| | |
|---|---|
| *dc* | data client handle features are registered for |

This method is called from the TEK after the data client was created and before is will be connected. See also Initialization of a data client plugin

A data client implementation should evaluate the configuration (passed to tek_sa_data_client_plugin::data_client_new) and register all known types fields, events, methods and alarms.

A connection to the controller must not be established.

Definition at line 1070 of file south_api.h.

### 9.1.2.2 connect

```
TEK_SA_RESULT(* tek_sa_data_client::connect) (tek_sa_data_client_handle dc)
```

Connect the data client to the data source.

This method is called from the TEK after the data client has registered ist features. See also Initialization of a data client plugin.

A data client implementation should connect to the data source and register additional features and capabilities.

If the data client can not connect to the data source it should keep trying to connect after the method call completed but it should not block.

Definition at line 1084 of file south_api.h.

#### 9.1.2.3 free

```
void(* tek_sa_data_client::free) (tek_sa_data_client_handle dc)
```

Frees the data client and releases all its resources.

Should be called by the TEK.

Definition at line 1091 of file south_api.h.

#### 9.1.2.4 read_fields

```
TEK_SA_RESULT(* tek_sa_data_client::read_fields) (tek_sa_data_client_handle dc, uint64_↩
t request_id, const tek_sa_field_handle items_to_read[], size_t number_of_items, bool do_not↩
_block)
```

Function to read one or more fields from the data client. The call may be executed in a synchronous or asynchronous manner (See parameter `do_not_block`).

The values of the requested fields are sent by calling the tek_sa_transformation_engine::read_result callback function. The data client must preserve the order of the fields in the results that are provided in tek_sa_transformation_engine::read_result callback.

If the time needed to retrive the values is larger then half the global timeout value a data client must call the vde_↩ sa_tek_ap::read_progress callback function.

**Parameters**

| | |
|---|---|
| *dc* | The handle of the data client as returned from tek_sa_data_client_plugin::data_client_new. |
| *request_id* | A unique request identifier which is created by the TEK and must be passed to call to tek_sa_transformation_engine::read_result and tek_sa_transformation_engine::read_progress. |
| *items_to_read* | An array of field handles which describes the values the data client should read. See also function tek_sa_transformation_engine::register_field. |
| *number_of_items* | The number of handles in the parameter `items_to_read`. |
| *do_not_block* | A boolean flag that, when set to *true*, tells the data client that it should return immediately and return the read field values later in another thread. |

### Returns

TEK_SA_ERR_SUCCESS when the call succeeded.

TEK_SA_ERR_NON_BLOCKING_IMPOSSIBLE if `do_not_block` is set to true and the called data client is not able to do nonblocking calls. The TEK will retry with `do_not_block` set to *false*

TEK_SA_ERR_OUT_OF_MEMORY when the data client can not allocate the data structures and resources to read the fields.

any other error which applies to the read function

**Todo** [B, TEAM] define error values of read function

### Attention

It is mandatory that the data client does not block when called with parameter `do_not_block` set to *true*.

### Usage of the Parameter `do_not_block`

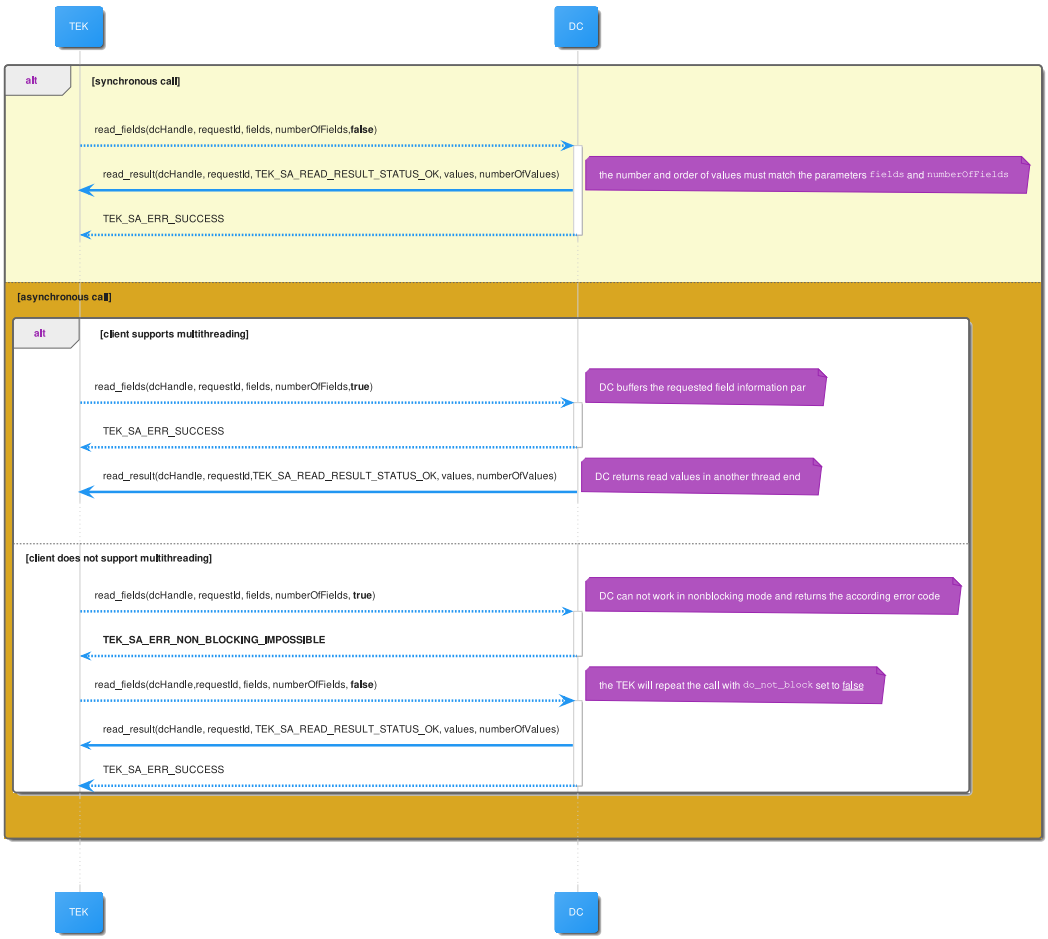



**Figure 9.1 Possible call sequences**

Definition at line 1185 of file south_api.h.

#### 9.1.2.5 write_fields

```
TEK_SA_RESULT(* tek_sa_data_client::write_fields) (tek_sa_data_client_handle dc, uint64_↩
t request_id, const struct tek_sa_field_write_request items_to_write[], size_t number_of_↩
items, bool do_not_block)
```

Function to write values to data client fields.

**Parameters**

| | |
|---|---|
| *dc* | The handle of the data client as returned from tek_sa_data_client_plugin::data_client_new. |
| *request_id* | A unique request identifier which is created by the TEK and must be passed to call to tek_sa_transformation_engine::write_result. |
| *items_to_write* | An array of field handles and their values which describes the values the data client should write. |
| *number_of_items* | The number of handles in the parameter `items_to_write`. |
| *do_not_block* | A boolean flag that, when set to *true*, tells the data client that it should return immediately and write the values in the background. See also Usage in `read_fields` |

**Todo** [B, TEAM] should the data client call a progress function if the operation needs more time?

Definition at line 1207 of file south_api.h.

#### 9.1.2.6 block_read

```
TEK_SA_RESULT(* tek_sa_data_client::block_read) (const tek_sa_data_client_handle dc, uint64_t
request_id, const char *filepath, uint64_t offset, int64_t length, bool do_not_block, int64_t
*filesize)
```

Starts a block transfer from the client to the TEK.

For example, read a file from the device.

**Parameters**

| | |
|---|---|
| *dc* | The data client handle |
| *request_id* | The request id for the TEK API callbacks |
| *filepath* | The file or address of the block to be read. The format is data client specific. The pointer must be in utf-8. |
| *offset* | The offset in the data |
| *length* | A specific length, or -1 for the whole data |
| *do_not_block* | See Usage in `read_fields` |
| *filesize* | The file size will be written by the data client, or -1 if not known at the call |

**Returns**

An information about the success or failure of the operation.

The data is not yet passed to this method directly but sent from the data client in chunks to the tek_sa_transformation_engine::block_read_data callback.

Definition at line 1232 of file south_api.h.

#### 9.1.2.7 block_write

```
TEK_SA_RESULT(* tek_sa_data_client::block_write) (const tek_sa_data_client_handle dc, uint64_t
request_id, const char *filepath, uint64_t offset, int64_t length, bool do_not_block)
```

Start a block transfer from the TEK to the data client.

**Parameters**

| | |
|---|---|
| *dc* | The handle of the data client as returned from tek_sa_data_client_plugin::data_client_new. |
| *request_id* | A unique request identifier which is created by the TEK and must be passed to call to tek_sa_transformation_engine::block_write_result and tek_sa_transformation_engine::block_write_data. |
| *offset* | The offset in the data |
| *length* | A specific length, or -1 for the whole data |
| *do_not_block* | See Usage in `read_fields` |

**Returns**

An information about the success or failure of the operation.

The data is not yet passed to this method directly but requested from the data client in chunks from the tek_sa_transformation_engine::block_write_data callback.

Definition at line 1255 of file south_api.h.

#### 9.1.2.8 subscribe

```
TEK_SA_RESULT(* tek_sa_data_client::subscribe) (tek_sa_data_client_handle dc, const tek_sa_field_handle
items_to_subscribe[], size_t number_of_items)
```

Subscribe to changes of one ore more data client fields.

**Parameters**

| | |
|---|---|
| *dc* | The handle of the data client as returned from tek_sa_data_client_plugin::data_client_new. |
| *items_to_subscribe* | The fields for which change events will be received. |
| *number_of_items* | The number of elements in the `items_to_subscribe` parameter. |

**Todo** [D, TEAM] add sampling rate parameter

The subscription mechanism is very easy compared to that of the OPC UA specification. The TEK can subscribe to each field only once and all changes are signaled by a call to the tek_sa_data_transformation_engine::notify_↩ change callback.

Definition at line 1275 of file south_api.h.

#### 9.1.2.9 unsubscribe

```
TEK_SA_RESULT(* tek_sa_data_client::unsubscribe) (tek_sa_data_client_handle dc, const tek_sa_field_handle
items_to_unsubscribe[], size_t number_of_items)
```

Unsubscribe to changes of one ore more data client fields.

**Parameters**

| | |
|---|---|
| *dc* | The handle of the data client as returned from tek_sa_data_client_plugin::data_client_new. |
| *items_to_unsubscribe* | The fields for which no more change events will be received. |
| *number_of_items* | The number of elements in the `items_to_unsubscribe` parameter. |

Definition at line 1288 of file south_api.h.

#### 9.1.2.10 invoke

```
TEK_SA_RESULT(* tek_sa_data_client::invoke) (const tek_sa_data_client_handle dc, const tek_sa_method_handle
method, uint64_t request_id, const tek_sa_field_value parameters[], const size_t number_of_↩
parameters)
```

Invoke a method on the data client.

**Providing this function ins optional**

**Parameters**

| | |
|---|---|
| *dc* | The handle of the data client as returned from tek_sa_data_client_plugin::data_client_new. |
| *method* | The method handle which is returned from the tek_sa_data_transformation_engine::register_method method. |
| *request_id* | A unique request identifier which is created by the TEK and must be passed to call to tek_sa_transformation_engine::block_write_result and tek_sa_transformation_engine::block_write_data. |
| *parameters* | The parameters of the method. Number and type must match the method registration. |
| *number_of_parameters* | The number of parameters in the `parameters` array. |

The outcome of the message call is returned in the tek_sa_transformation_engine::call_method_result callback.

Definition at line 1314 of file south_api.h.

#### 9.1.2.11 acknowledge_alarm

```
void(* tek_sa_data_client::acknowledge_alarm) (tek_sa_data_client_handle dc, const tek_sa_alarm_handle
alarm)
```

Acknowledge an alarm in the data client.

**Parameters**

| | |
|---|---|
| *dc* | The handle of the data client as returned from tek_sa_data_client_plugin::data_client_new. |
| *alarm* | An alarm handle which is returned from the method tek_sa_transformation_engine::register_alarm. |

Called by TEK to signal triggered alarm has acknowledged by TEK consumer. The alarm may or may not be raised before with a call to tek_sa_transformation_engine::set_alarm. When the alarm condition is not true anymore, then the data client implementation has to reset the alarm and call tek_sa_transformation_engine::reset_alarm

Definition at line 1333 of file south_api.h.

#### 9.1.2.12 handle

```
tek_sa_data_client_handle tek_sa_data_client::handle
```

The handle that is passed as first parameter in all functions of this interface.

Definition at line 1345 of file south_api.h.

The documentation for this struct was generated from the following file:

- include/south_api.h

## 9.2 tek_sa_data_client_plugin Struct Reference

Interface of the data client plugin.

```
#include <south_api.h>
```

## Data Fields

- void ∗ plugin_context

  *The (private) plugin context. Must be freed using free_context on unloading the plugin.*
- TEK_SA_RESULT(∗ data_client_new )(void ∗plugin_context, const struct tek_sa_configuration ∗config, struct tek_sa_data_client ∗created_client, struct tek_sa_data_client_capabilities ∗capabilities)

  *Allocates and initializes the data client with a configuration. Prepare callbacks in data_client.*
- void(∗ free_context )(void ∗plugin_context)

  *Frees the private context of the plugin.*

### 9.2.1 Detailed Description

Interface of the data client plugin.

The data client plugin is created once as result of a call to the `load_plugin` method();

Definition at line 1369 of file south_api.h.

### 9.2.2 Field Documentation

#### 9.2.2.1 plugin_context

```
void* tek_sa_data_client_plugin::plugin_context
```

The (private) plugin context. Must be freed using free_context on unloading the plugin.

Definition at line 1374 of file south_api.h.

#### 9.2.2.2 data_client_new

```
TEK_SA_RESULT(* tek_sa_data_client_plugin::data_client_new) (void *plugin_context, const struct
tek_sa_configuration *config, struct tek_sa_data_client *created_client, struct tek_sa_data_client_capabilitie
*capabilities)
```

Allocates and initializes the data client with a configuration. Prepare callbacks in data_client.

Does not perform any actions like connecting to the data source or register information at the TEK.

**Parameters**

| | |
|---|---|
| *plugin_context* | |
| *config* | |
| *created_client* | |
| *capabilities* | The data client capabilities (known before connect), e.g. the threading model of the data client. Capabilities can be updated by the client using the TEK API, if additional information are retrieved later in the lifecycle of the data client. |

**Returns**

failure code or success

Definition at line 1392 of file south_api.h.

#### 9.2.2.3 free_context

```
void(* tek_sa_data_client_plugin::free_context) (void *plugin_context)
```

Frees the private context of the plugin.

Definition at line 1399 of file south_api.h.

The documentation for this struct was generated from the following file:

- include/south_api.h

## 9.3 tek_sa_transformation_engine Struct Reference

Interface ot the Transformation Engine.

```
#include <south_api.h>
```

### Data Fields

**Registration functions for data client operations and data fields**

- tek_sa_field_handle(* register_field )(tek_sa_data_client_handle dc, const char *name, enum tek_sa_field_attributes attributes, enum tek_sa_variant_type type)
  *Registers a new field of a data client with a name inside the TEK.*
- tek_sa_method_handle(* register_method )(tek_sa_data_client_handle dc, const char *name, struct tek_sa_method_argument_description input_parameter[], size_t number_of_input_parameters, struct tek_sa_method_argument_description output_parameter[], size_t number_of_output_parameters)
  *Registers a new method at the TEK.*
- tek_sa_event_handle(* register_event )(tek_sa_data_client_handle dc, const char *name)
  *Registers a new Event that a data client might raise.*
- tek_sa_alarm_handle(* register_alarm )(tek_sa_data_client_handle dc, const char *name, const int16_t severity, const tek_sa_field_handle source)
  *Registers an alarm at the TEK.*

**Registration functions for extended types**

- TEK_SA_RESULT(* register_enum_type )(tek_sa_data_client_handle dc, struct tek_sa_enum_definition const *type_definition, tek_sa_type_handle *result)
  *Register a user defined enum type.*
- TEK_SA_RESULT(* register_struct_type )(tek_sa_data_client_handle dc, struct tek_sa_struct_definition const *type_definition, tek_sa_type_handle *result)
  *Register a user defined struct type.*

**Alarm and Event functions**

- TEK_SA_RESULT(∗ post_event )(tek_sa_data_client_handle dc, struct tek_sa_dc_event const ∗event)
  *Post an event which was declared with a call to either get_global_event or register_event.*
- TEK_SA_RESULT(∗ set_alarm )(tek_sa_data_client_handle dc, const tek_sa_alarm_handle alarm)
  *Sets an alarm.*
- TEK_SA_RESULT(∗ reset_alarm )(tek_sa_data_client_handle dc, const tek_sa_alarm_handle alarm)
  *Clears/resets an alarm.*

**Miscellaneous functions**

- void(∗ log )(tek_sa_data_client_handle source, enum tek_sa_log_level_t lvl, const char ∗format, va_list args)
  *Logging function for data clients.*
- tek_sa_event_handle(∗ get_global_event )(const char ∗name)
  *Get a handle of a globally defined event.*
- void(∗ update_capabilities )(tek_sa_data_client_handle dc, struct tek_sa_data_client_capabilities const ∗capabilities)
  *Notifies the TEK of the change of the client's capabilities.*

**Data client callbacks**

- void(∗ read_progress )(tek_sa_data_client_handle dc, uint64_t request_id, uint64_t progress)
  *Callback to signal progress of a read operation to the TEK.*
- void(∗ read_result )(tek_sa_data_client_handle dc, uint64_t request_id, TEK_SA_RESULT result, const struct tek_sa_read_result results[ ], size_t number_of_results)
  *Callback of the data client read operation.*
- void(∗ notify_change )(tek_sa_data_client_handle dc, const struct tek_sa_read_result changes[ ], size_t number_of_changes)
  *Callback to notify about a change of subscribed data fields.*
- void(∗ write_result )(tek_sa_data_client_handle dc, uint64_t request_id, TEK_SA_RESULT result, const struct tek_sa_write_result results[ ], size_t number_of_results)
  *Callback of the data client write operation.*
- void(∗ call_method_result )(tek_sa_data_client_handle dc, uint64_t request_id, TEK_SA_RESULT result, const tek_sa_field_value results[ ], size_t number_of_results)
  *Callback of a data client method call.*
- TEK_SA_RESULT(∗ block_read_data )(tek_sa_data_client_handle dc, uint64_t request_id, TEK_SA_RESULT result, unsigned char buffer[ ], size_t buffer_length)
  *Callback from the data client to the TEK signaling the next data chunk of the block transfer.*
- TEK_SA_RESULT(∗ block_write_data )(tek_sa_data_client_handle dc, uint64_t request_id, unsigned char buffer[ ], size_t buffer_length, size_t ∗bytes_written)
  *Callback from the data client to the TEK requesting another chunk to write to the data client.*
- void(∗ block_write_result )(tek_sa_data_client_handle dc, uint64_t request_id, TEK_SA_RESULT result)
  *Callback from the data client to the TEK with the final result of the block transfer.*

### 9.3.1 Detailed Description

Interface ot the Transformation Engine.

Interface exported by the TEK, which is given a data client plugin (dll/so) to interact with the TEK.

**Todo** [A, TEAM] inconsistent register∗ methods signatures: always return error code or handle

Definition at line 1417 of file south_api.h.

## 9.3.2 Field Documentation

### 9.3.2.1 register_field

```
tek_sa_field_handle(* tek_sa_transformation_engine::register_field) (tek_sa_data_client_handle
dc, const char *name, enum tek_sa_field_attributes attributes, enum tek_sa_variant_type type)
```

Registers a new field of a data client with a name inside the TEK.

**Parameters**

| | |
|---|---|
| *dc* | The data client that registers at the TEK. |
| *name* | The name of the field. The data client decides the name. |
| *attributes* | The attributes of the field, e.g. is writeable. |
| *type* | The data type of the field. |

**Returns**

A valid field_handle or INVALID_FIELD_HANDLE.

Definition at line 1431 of file south_api.h.

### 9.3.2.2 register_method

```
tek_sa_method_handle(* tek_sa_transformation_engine::register_method) (tek_sa_data_client_handle
dc, const char *name, struct tek_sa_method_argument_description input_parameter[], size_↩
t number_of_input_parameters, struct tek_sa_method_argument_description output_parameter[],
size_t number_of_output_parameters)
```

Registers a new method at the TEK.

**Parameters**

| | |
|---|---|
| *dc* | The data client that registers at the TEK. |
| *name* | The name of the method. |
| *tek_sa_method_argument_description* | The description of the method input arguments. |
| *number_of_input_parameters* | The number of input parameters. |
| *tek_sa_method_argument_description* | The description of the method output arguments. |
| *number_of_output_parameters* | The number of output parameters. |

**Returns**

A tek_sa_method_handle.

Definition at line 1449 of file south_api.h.

#### 9.3.2.3 register_event

```
tek_sa_event_handle(* tek_sa_transformation_engine::register_event) (tek_sa_data_client_handle
dc, const char *name)
```

Registers a new Event that a data client might raise.

**Parameters**

| | |
|---|---|
| *dc* | The data client that registers at the TEK. |
| *name* | The name of the event. Must be unique within all events registered from this dc. |

**Returns**

A tek_sa_event_handle or TEK_SA_EVENT_HANDLE_INVALID, if the event registration failed (e.g. duplicate registration, empty name...).

The TEK ensures that the set of handles between the predefined events and the registered events are disjoint.

Definition at line 1468 of file south_api.h.

#### 9.3.2.4 register_alarm

```
tek_sa_alarm_handle(* tek_sa_transformation_engine::register_alarm) (tek_sa_data_client_handle
dc, const char *name, const int16_t severity, const tek_sa_field_handle source)
```

Registers an alarm at the TEK.

**Parameters**

| | |
|---|---|
| *dc* | The data client that registers at the TEK. |
| *name* | The name of the new alarm, must be unique within all alarms registered for this data client. |
| *severity* | The alarm severity level. |
| *source* | field the alarm relates to, the same field can be used for multiple alarms. |

**Returns**

A tek_sa_alarm_handle or TEK_SA_ALARM_HANDLE_INVALID, if the alarm registration failed (e.g. duplicate registration, empty name...).

Definition at line 1484 of file south_api.h.

#### 9.3.2.5 register_enum_type

```
TEK_SA_RESULT(* tek_sa_transformation_engine::register_enum_type) (tek_sa_data_client_handle
dc, struct tek_sa_enum_definition const *type_definition, tek_sa_type_handle *result)
```

Register a user defined enum type.

**Parameters**

| | |
|---|---|
| *dc* | The data client that registers at the TEK. |
| *tek_sa_enum_definition* | The definition of the enumeration. |
| *result* | A tek_sa_type_handle associated to the registered enum. |

**Returns**

indicator whether the type definition was successfully registered

Definition at line 1504 of file south_api.h.

#### 9.3.2.6 register_struct_type

```
TEK_SA_RESULT(* tek_sa_transformation_engine::register_struct_type) (tek_sa_data_client_handle
dc, struct tek_sa_struct_definition const *type_definition, tek_sa_type_handle *result)
```

Register a user defined struct type.

**Parameters**

| | |
|---|---|
| *dc* | The data client that registers at the TEK. |
| *tek_sa_struct_definition* | The definition of the struct. |
| *result* | A tek_sa_type_handle associated to the registered struct. |

**Returns**

indicator whether the type definition was successfully registered

Definition at line 1517 of file south_api.h.

#### 9.3.2.7 post_event

```
TEK_SA_RESULT(* tek_sa_transformation_engine::post_event) (tek_sa_data_client_handle dc, struct
tek_sa_dc_event const *event)
```

Post an event which was declared with a call to either get_global_event or register_event.

**Parameters**

| | |
|---|---|
| *dc* | Handle of the data client which sends the event. |
| *event* | A event structure. See `dc_event`. |

**Returns**

indicator whether the event was successfully posted or not

Definition at line 1537 of file south_api.h.

#### 9.3.2.8 set_alarm

```
TEK_SA_RESULT(* tek_sa_transformation_engine::set_alarm) (tek_sa_data_client_handle dc, const
tek_sa_alarm_handle alarm)
```

Sets an alarm.

**Parameters**

| | |
|---|---|
| *dc* | Handle of the data client that sets the alarm. |
| *alarm* | Handle of the alarm to be set. |

**Returns**

indicator whether setting the alarm was successful or not

**Todo** [C, TEAM] called by data_client after connect, regardless of "acknowledge" calls during previous connection?

Definition at line 1550 of file south_api.h.

#### 9.3.2.9 reset_alarm

```
TEK_SA_RESULT(* tek_sa_transformation_engine::reset_alarm) (tek_sa_data_client_handle dc,
const tek_sa_alarm_handle alarm)
```

Clears/resets an alarm.

**Parameters**

| | |
|---|---|
| *dc* | Handle of the data client that clears/resets the alarm. |
| *alarm* | Handle of the alarm to be cleared/reset. |

**Returns**

indicator whether resetting the alarm was successful or not

Definition at line 1560 of file south_api.h.

#### 9.3.2.10 log

```
void(* tek_sa_transformation_engine::log) (tek_sa_data_client_handle source, enum tek_sa_log_level_t
lvl, const char *format, va_list args)
```

Logging function for data clients.

The TEK bundles the messages of all data clients.

The TEK must be aware of data clients running in different threads than the TEK itself and is responsible for handling multi-threaded access to the function.

**Parameters**

| | |
|---|---|
| *data_client_handle* | The data client that logs a message. |
| *lvl* | The logging level. |
| *format* | The message format string. Format must be compatible to `printf`. |
| *args* | A va_list that contains all the arguments for the format string. |

Definition at line 1584 of file south_api.h.

#### 9.3.2.11 get_global_event

```
tek_sa_event_handle(* tek_sa_transformation_engine::get_global_event) (const char *name)
```

Get a handle of a globally defined event.

**Parameters**

| | |
|---|---|
| *name* | name of globally defined event. |

**Returns**

handle to globally defined event

**Todo** [C, TEAM] define the predefined events

[C, TEAM] define return value when event with given name does not exist?

The TEK ensures that the set of handles between the predefined events and the registered events are disjoint.

Definition at line 1600 of file south_api.h.

#### 9.3.2.12 update_capabilities

```
void(* tek_sa_transformation_engine::update_capabilities) (tek_sa_data_client_handle dc, struct
tek_sa_data_client_capabilities const *capabilities)
```

Notifies the TEK of the change of the client's capabilities.

**Parameters**

| | |
|---|---|
| *dc* | Handle of the data client that informs about the change of its capabilities. |
| *tek_sa_data_client_capabilities* | The updated client capabilities. |

**Returns**

(void)

Definition at line 1609 of file south_api.h.

#### 9.3.2.13 read_progress

```
void(* tek_sa_transformation_engine::read_progress) (tek_sa_data_client_handle dc, uint64_↩
t request_id, uint64_t progress)
```

Callback to signal progress of a read operation to the TEK.

**Parameters**

| | |
|---|---|
| *dc* | Handle of the data client that is the source of the call |
| *request↩ _id* | id of request to data client which triggered the call back |
| *progress* | ?? (percentage? why uint64?) |

**Todo** [B, TEAM] when should a data client report progress?

**Todo** [B, TEAM] when can the TEK stop the client (after progress was not reported)?

Definition at line 1632 of file south_api.h.

#### 9.3.2.14 read_result

```
void(* tek_sa_transformation_engine::read_result) (tek_sa_data_client_handle dc, uint64_↩
t request_id, TEK_SA_RESULT result, const struct tek_sa_read_result results[], size_t number↩
_of_results)
```

Callback of the data client read operation.

**Parameters**

| | |
|---|---|
| *dc* | Handle of the data client that is the source of the call |
| *request_id* | id of request to data client that triggered the call back |
| *result* | status code for read request |
| *results* | read values |
| *number_of_results* | length of results array |

If the result is success, then the following constraints must hold:

The number of results MUST be equal to the number of fields requested in read_fields. The order of results MUST be the same as the order of fields in read_fields. The results array is only valid during the execution of the callback.

If the result is failure, the TEK MUST ignore the results and number_of_results parameters.

Definition at line 1656 of file south_api.h.

#### 9.3.2.15 notify_change

```
void(* tek_sa_transformation_engine::notify_change) (tek_sa_data_client_handle dc, const struct
tek_sa_read_result changes[], size_t number_of_changes)
```

Callback to notify about a change of subscribed data fields.

**Parameters**

| | |
|---|---|
| *dc* | Handle of the data client that is the source of the change |
| *changes* | changed field values |
| *number_of_changes* | length of changes array |

Definition at line 1668 of file south_api.h.

#### 9.3.2.16 write_result

```
void(* tek_sa_transformation_engine::write_result) (tek_sa_data_client_handle dc, uint64_t
request_id, TEK_SA_RESULT result, const struct tek_sa_write_result results[], size_t number↩
_of_results)
```

Callback of the data client write operation.

**Parameters**

| | |
|---|---|
| *dc* | Handle of the data client data was written to |
| *request_id* | id of write request to data client that triggered the call back |
| *result* | overall result of write operation |
| *results* | write results for each written field |
| *number_of_results* | length of results array |

Definition at line 1682 of file south_api.h.

#### 9.3.2.17 call_method_result

```
void(* tek_sa_transformation_engine::call_method_result) (tek_sa_data_client_handle dc, uint64↩
_t request_id, TEK_SA_RESULT result, const tek_sa_field_value results[], size_t number_of_↩
results)
```

Callback of a data client method call.

**Parameters**

| | |
|---|---|
| *dc* | Handle of the data client a method was called at |
| *request_id* | id of method call request to data client that triggered the call back |
| *result* | error/success indicator of method call |
| *results* | return values of method call, only valid for successful results |
| *number_of_results* | length of results array |

Definition at line 1698 of file south_api.h.

#### 9.3.2.18 block_read_data

```
TEK_SA_RESULT(* tek_sa_transformation_engine::block_read_data) (tek_sa_data_client_handle dc,
uint64_t request_id, TEK_SA_RESULT result, unsigned char buffer[], size_t buffer_length)
```

Callback from the data client to the TEK signaling the next data chunk of the block transfer.

**Parameters**

| | |
|---|---|
| *dc* | The data client handle. |
| *request_id* | The request id of the block transfer. |
| *result* | The data client signals success, error, or end-of-file. Buffer may contain a last chunk when end-of-file is signalled. If an error is signalled, the data client has aborted the process and will not call this callback again for the request. |
| *buffer* | The current chunk of the file. The TEK must copy the data into it's own process. |
| *buffer_length* | The length of the chunk. |

**Returns**

The TEK responds with success, or can abort the transfer.

Definition at line 1719 of file south_api.h.

#### 9.3.2.19 block_write_data

```
TEK_SA_RESULT(* tek_sa_transformation_engine::block_write_data) (tek_sa_data_client_handle dc,
uint64_t request_id, unsigned char buffer[], size_t buffer_length, size_t *bytes_written)
```

Callback from the data client to the TEK requesting another chunk to write to the data client.

**Parameters**

| | |
|---|---|
| *dc* | The data client handle. |
| *request_id* | The request id of the block transfer. |
| *buffer* | The buffer to write the chunk of the file. The TEK must copy the data into the buffer provided by the data client. |
| *buffer_length* | The length of the buffer in the data client. |
| *bytes_written* | The number of bytes written in the buffer by the TEK. |
| *result* | Signals valid next chunk, end-of-file, abort or error. |

**Returns**

Success or failure code.

Definition at line 1736 of file south_api.h.

#### 9.3.2.20 block_write_result

```
void(* tek_sa_transformation_engine::block_write_result) (tek_sa_data_client_handle dc, uint64↩
_t request_id, TEK_SA_RESULT result)
```

Callback from the data client to the TEK with the final result of the block transfer.

**Parameters**

| | |
|---|---|
| *dc* | The data client handle. |
| *request↩ _id* | The request id of the block transfer. |
| *result* | The final result. |

Definition at line 1747 of file south_api.h.

The documentation for this struct was generated from the following file:

- include/south_api.h

# Chapter 10

# File Documentation

## 10.1 include/south_api.h File Reference

Definition of the interface between Data Clients (DC) and the Transformation Engine (TEK)

```
#include <stdarg.h>
#include <stddef.h>
#include <stdbool.h>
#include <stdint.h>
#include <stdlib.h>
```

### Data Structures

- struct tek_sa_additional_file

  *Configuration class which describes an additional file which is passed to the data client. More...*
- struct tek_sa_configuration

  *Configuration object containing the contents of the configuration files for the tek_sa_data_client_plugin or tek_sa_data_client instances. More...*
- struct tek_sa_guid

  *The representation of a GUID when used as a field type. More...*
- struct tek_sa_byte_string

  *The representation of a byte array with variable length when used as a field type. More...*
- struct tek_sa_string

  *The representation of a string with variable length when used as a field type. More...*
- struct tek_sa_complex_data

  *The representation of a field value which has a type which is not a predefined type. More...*
- struct tek_sa_complex_data_array_item

  *The representation of the items of an array of complex data values with exactly one dimension. More...*
- struct tek_sa_complex_data_array

  *The representation of an array of complex data with exactly one dimension. More...*
- struct tek_sa_complex_data_matrix

  *The representation of array of complex data with more than one dimension. More...*
- struct tek_sa_variant_array

  *The representation of a one dimensional array of the supported base types. More...*
- struct tek_sa_variant_matrix

*The representation of an array with more than one dimension of the supported base types. More...*

- struct tek_sa_variant

  *The representation of a single value (which may be of array type too). More...*
- struct tek_sa_struct_field_type_definition

  *The type definition of a record field in a user defined struct type. More...*
- struct tek_sa_struct_definition

  *The type definition of a user defined record type. More...*
- struct tek_sa_enum_item_definition

  *The definition of an enum item which is defined in a user defined enum type. More...*
- struct tek_sa_enum_definition

  *The type definition of a user defined enum type. More...*
- struct tek_sa_method_argument_description

  *The description of a method parameter. More...*
- struct tek_sa_field_write_request

  *Structure to encapsulate the parameters of a write field request. More...*
- struct tek_sa_write_result

  *Structure to encapsulate the result of a write field request. More...*
- struct tek_sa_read_result

  *Structure to encapsulate the result of a read operation of a single field. More...*
- struct tek_sa_event_parameter

  *Structure to encapsulate an event parameter. More...*
- struct tek_sa_dc_event

  *An event which may be sent from the data client to tek_sa_transformation_engine::post_event. More...*
- struct tek_sa_data_client_capabilities

  *capabilities of the data client. These capabilities are applied to the complete data client as well as to each instance (device connection). More...*
- struct tek_sa_data_client

  *The interface of one instance of a data client.*
- struct tek_sa_data_client_plugin

  *Interface of the data client plugin.*
- struct tek_sa_transformation_engine

  *Interface ot the Transformation Engine.*
- union tek_sa_variant_array.data

  *The array values. More...*
- union tek_sa_variant.data

  *The value. More...*

## Macros

- #define TEK_SA_API_VERSION_MAJOR 0
- #define TEK_SA_API_VERSION_MINOR 1
- #define TEK_SA_API_VERSION_PATCH 0
- #define TEK_SA_API_VERSION "0.1.0"

### Handle Constants

- #define TEK_SA_FIELD_HANDLE_INVALID 0

  *An always invalid field handle.*
- #define TEK_SA_EVENT_HANDLE_INVALID 0

  *An always invalid event handle.*
- #define TEK_SA_ALARM_HANDLE_INVALID 0

  *An always invalid alarm handle.*
- #define TEK_SA_METHOD_HANDLE_INVALID 0

  *An always invalid method handle.*

## Typedefs

- typedef void * tek_sa_data_client_handle

  *The type of the data client handle.*
- typedef int64_t tek_sa_type_handle

  *The type of a handle which is returned for user defined types.*
- typedef int64_t tek_sa_type_handle_or_type_enum

  *The type for a reference handle which references either a user defined type (see tek_sa_type_handle) or a predefined type (See tek_sa_variant_type.)*
- typedef int64_t tek_sa_datetime

  *The type of date and time values wen used as a field type.*
- typedef struct tek_sa_variant tek_sa_field_value

  *Type of data client field values.*
- typedef uint32_t tek_sa_field_handle

  *Handle type for a field definition.*
- typedef uint32_t tek_sa_event_handle

  *Handle type for an event definition.*
- typedef uint32_t tek_sa_alarm_handle

  *Handle type for an alarm definition.*
- typedef uint32_t tek_sa_method_handle

  *Handle type for a method definition.*
- typedef TEK_SA_RESULT(* tek_sa_load_plugin_fn) (struct tek_sa_transformation_engine *api, const struct tek_sa_configuration *plugin_configuration, struct tek_sa_data_client_plugin *plugin)

  *Signature for the load plugin function.*

## Enumerations

- enum tek_sa_variant_type {
  TEK_SA_VARIANT_TYPE_NULL = 0x0 , TEK_SA_VARIANT_TYPE_BOOL = 0x1 , TEK_SA_VARIANT_TYPE_UINT8_T = 0x2 , TEK_SA_VARIANT_TYPE_INT8_T = 0x3 ,
  TEK_SA_VARIANT_TYPE_UINT16_T = 0x4 , TEK_SA_VARIANT_TYPE_INT16_T = 0x5 , TEK_SA_VARIANT_TYPE_UINT32 = 0x6 , TEK_SA_VARIANT_TYPE_INT32_T = 0x7 ,
  TEK_SA_VARIANT_TYPE_UINT64_T = 0x8 , TEK_SA_VARIANT_TYPE_INT64_T = 0x9 , TEK_SA_VARIANT_TYPE_FLOAT = 0xa , TEK_SA_VARIANT_TYPE_DOUBLE = 0xb ,
  TEK_SA_VARIANT_TYPE_DATETIME = 0xc , TEK_SA_VARIANT_TYPE_STRING = 0xd , TEK_SA_VARIANT_TYPE_GUID = 0xe , TEK_SA_VARIANT_TYPE_BYTE_STRING = 0xf ,
  TEK_SA_VARIANT_TYPE_COMPLEX = 0x20 , TEK_SA_VARIANT_TYPE_FLAG_ARRAY = 0x40 ,
  TEK_SA_VARIANT_TYPE_FLAG_MATRIX = 0x80 }

  *The predefined types which can be processed in the TE.*
- enum tek_sa_field_attributes { TEK_SA_FIELD_ATTRIBUTES_WRITABLE = 0x1 , TEK_SA_FIELD_ATTRIBUTES_READABLE = 0x2 , TEK_SA_FIELD_ATTRIBUTES_SUBSCRIBABLE = 0x4 }

  *Flags type which contains the attributes of a data client field.*
- enum tek_sa_log_level_t {
  TEK_SA_LOG_LEVEL_TRACE = 0x0 , TEK_SA_LOG_LEVEL_DEBUG = 0x1 , TEK_SA_LOG_LEVEL_INFO = 0x2 , TEK_SA_LOG_LEVEL_WARNING = 0x3 ,
  TEK_SA_LOG_LEVEL_ERROR = 0x4 , TEK_SA_LOG_LEVEL_CRITICAL = 0x5 }

  *Definition of the possible logging levels which can be used in tek_sa_transformation_engine::log.*
- enum tek_sa_threading_model { TEK_SA_THREADING_MODEL_SAME_THREAD = 0x0 , TEK_SA_THREADING_MODEL_S = 0x1 , TEK_SA_THREADING_MODEL_PARALLEL = 0x2 }

  *Describes the threading model of a data client instance of a data client plugin.*

### StatusCodes

- #define TEK_SA_ERR_SUCCESS 0

  *An operation was completed successfully.*
- #define TEK_SA_ERR_NON_BLOCKING_IMPOSSIBLE 10

  *A data client function was called in an asynchronous manner while the implementation can not use multiple threads.*
- #define TEK_SA_ERR_OUT_OF_MEMORY 11

  *The data client or the Transformation Engine can not process a request because it has no more system resources.*
- #define TEK_SA_ERR_INVALID_PARAMETER 12

  *The parameters passed to the function are invalid.*
- #define TEK_SA_ERR_RETRY_LATER 0xffffffff

  *A data client function was called in an asynchronous manner while the number of inflight calls is already active.*
- #define TEK_SA_READ_RESULT_STATUS_OK 0

  *A read operation completed successfully.*
- #define TEK_SA_READ_RESULT_STATUS_NOK 1

  *A read operation failed.*
- #define TEK_SA_READ_RESULT_STATUS_TIMEOUT 2

  *A read operation did not complete within the specified time limit.*
- #define TEK_SA_READ_RESULT_STATUS_INVALID_HANDLE 3

  *The read operation failed because the passed field handle was invalid.*
- #define TEK_SA_BLOCK_TRANSFER_END_OF_FILE 26

  *The read operation read until the end of file.*
- #define TEK_SA_BLOCK_TRANSFER_ABORT 24

  *The block read or write operation should be stopped.*
- typedef int TEK_SA_RESULT

  *The return value type of all interface functions (which need to return information about success of the operation).*

## 10.1.1 Detailed Description

Definition of the interface between Data Clients (DC) and the Transformation Engine (TEK)

This header file conforms to the following standards:

- ISO/IEC 9899:1990 (C90)
- ISO/IEC 14882:1998 (C++98)

To ensure binary compatibility of the interface between different compilers and different versions of the interface, the struct offset of each struct member is verified at compile time. This check is realized by the TEK_SA_VERIFY↩ _STRUCT_OFFSET macro.

Definition in file south_api.h.

## 10.1.2 Macro Definition Documentation

#### 10.1.2.1 TEK_SA_API_VERSION_MAJOR

```
#define TEK_SA_API_VERSION_MAJOR 0
```

Definition at line 19 of file south_api.h.

#### 10.1.2.2 TEK_SA_API_VERSION_MINOR

```
#define TEK_SA_API_VERSION_MINOR 1
```

Definition at line 20 of file south_api.h.

#### 10.1.2.3 TEK_SA_API_VERSION_PATCH

```
#define TEK_SA_API_VERSION_PATCH 0
```

Definition at line 21 of file south_api.h.

#### 10.1.2.4 TEK_SA_API_VERSION

```
#define TEK_SA_API_VERSION "0.1.0"
```

Definition at line 22 of file south_api.h.

## 10.2 south_api.h

Go to the documentation of this file.

```
00001 #ifndef TEK_SOUTH_API_H
00002 #define TEK_SOUTH_API_H
00003
00019 #define TEK_SA_API_VERSION_MAJOR 0
00020 #define TEK_SA_API_VERSION_MINOR 1
00021 #define TEK_SA_API_VERSION_PATCH 0
00022 #define TEK_SA_API_VERSION "0.1.0"
00023
00024 #include <stdarg.h>
00025 #include <stddef.h>
00026 #include <stdbool.h>
00027 #include <stdint.h>
00028 #include <stdlib.h>
00029
00030
00031 #define TEK_SA_STRUCT_ALIGN_SELECT(O32, O64) (sizeof(void*) == 8 ? O64 : O32)
00032
00033 #if defined __STDC_VERSION__ && __STDC_VERSION__ >= 201112L
00034   #include <assert.h>
00035   #define TEK_SA_VERIFY_STRUCT_OFFSET(S, M, O32, O64) ; \
00036     _Static_assert(offsetof(struct S, M) == TEK_SA_STRUCT_ALIGN_SELECT(O32, O64), "struct offset of
       field "#M" in "#S" must be correct")
00037 #else
00038   #define TEK_SA_VERIFY_STRUCT_OFFSET(S, M, O32, O64) ; \
00039     enum { S##__##M##_offset = 1/(int)(!!(offsetof(struct S, M) == TEK_SA_STRUCT_ALIGN_SELECT(O32,
       O64)))};
```

```
00040 #endif
00041
00042 #ifdef __cplusplus
00043 extern "C" {
00044 #endif
00045
00233 typedef void* tek_sa_data_client_handle;
00234
00235 /*****************************************************************************************************
00236  * Configuration structures
00237  *****************************************************************************************************/
00238
00243 struct tek_sa_additional_file {
00245   char* name;
00246
00248   char* content;
00249 };
00250
00251 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_additional_file, name, 0, 0);
00252 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_additional_file, content, 4, 8);
00253
00258 struct tek_sa_configuration {
00260   char* config;
00261
00263   struct tek_sa_additional_file* additional_files;
00264
00266   size_t additional_files_count;
00267 };
00268
00269 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_configuration, config, 0, 0);
00270 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_configuration, additional_files, 4, 8);
00271 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_configuration, additional_files_count, 8, 16);
00272
00273 /*****************************************************************************************************
00274  * Built-in type definitions and variant
00275  *****************************************************************************************************/
00276
00285 typedef int64_t tek_sa_type_handle;
00286
00291 typedef int64_t tek_sa_type_handle_or_type_enum;
00292
00301 struct tek_sa_guid {
00303   uint32_t data1;
00304
00306   uint16_t data2;
00307
00309   uint16_t data3;
00310
00312   uint8_t data4[8];
00313 };
00314 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_guid, data1, 0, 0);
00315 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_guid, data2, 4, 4);
00316 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_guid, data3, 6, 6);
00317 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_guid, data4, 8, 8);
00318
00326 struct tek_sa_byte_string {
00328   int32_t length;
00329
00331   unsigned char* data;
00332 };
00333 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_byte_string, length, 0, 0);
00334 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_byte_string, data, 4, 8);
00335
00344 struct tek_sa_string {
00346   int32_t length;
00347
00349   unsigned char* data;
00350 };
00351 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_string, length, 0, 0);
00352 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_string, data, 4, 8);
00353
00360 typedef int64_t tek_sa_datetime;
00361
00369 struct tek_sa_complex_data {
00371   tek_sa_type_handle type;
00372
00379   uint32_t data_length;
00380
00387   unsigned char* data;
00388 };
00389 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_complex_data, type, 0, 0);
00390 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_complex_data, data_length, 8, 8);
00391 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_complex_data, data, 12, 16);
00392
00399 struct tek_sa_complex_data_array_item {
00407   uint32_t data_length;
00408
```

```
00414   unsigned char* data;
00415 };
00416 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_complex_data_array_item, data_length, 0, 0);
00417 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_complex_data_array_item, data, 4, 8);
00418
00428 struct tek_sa_complex_data_array {
00430   tek_sa_type_handle type;
00431
00433   size_t number_of_items;
00434
00437   struct tek_sa_complex_data_array_item* data;
00438 };
00439
00440 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_complex_data_array, type, 0, 0);
00441 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_complex_data_array, number_of_items, 8, 8);
00442 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_complex_data_array, data, 12, 16);
00443
00453 struct tek_sa_complex_data_matrix {
00455   tek_sa_type_handle type;
00456
00458   int32_t dimension_length;
00459
00474   int32_t* dimensions;
00475
00478   struct tek_sa_complex_data_array_item* data;
00479 };
00480 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_complex_data_matrix, type, 0, 0);
00481 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_complex_data_matrix, dimension_length, 8, 8);
00482 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_complex_data_matrix, dimensions, 12, 16);
00483 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_complex_data_matrix, data, 16, 24);
00484
00492 enum tek_sa_variant_type {
00494   TEK_SA_VARIANT_TYPE_NULL = 0x0,
00495
00497   TEK_SA_VARIANT_TYPE_BOOL = 0x1,
00498
00500   TEK_SA_VARIANT_TYPE_UINT8_T = 0x2,
00501
00503   TEK_SA_VARIANT_TYPE_INT8_T = 0x3,
00504
00506   TEK_SA_VARIANT_TYPE_UINT16_T = 0x4,
00507
00509   TEK_SA_VARIANT_TYPE_INT16_T = 0x5,
00510
00512   TEK_SA_VARIANT_TYPE_UINT32_T = 0x6,
00513
00515   TEK_SA_VARIANT_TYPE_INT32_T = 0x7,
00516
00518   TEK_SA_VARIANT_TYPE_UINT64_T = 0x8,
00519
00521   TEK_SA_VARIANT_TYPE_INT64_T = 0x9,
00522
00524   TEK_SA_VARIANT_TYPE_FLOAT = 0xa,
00525
00527   TEK_SA_VARIANT_TYPE_DOUBLE = 0xb,
00528
00530   TEK_SA_VARIANT_TYPE_DATETIME = 0xc,
00531
00533   TEK_SA_VARIANT_TYPE_STRING = 0xd,
00534
00536   TEK_SA_VARIANT_TYPE_GUID = 0xe,
00537
00539   TEK_SA_VARIANT_TYPE_BYTE_STRING = 0xf,
00540
00543   TEK_SA_VARIANT_TYPE_COMPLEX = 0x20,
00544
00547   TEK_SA_VARIANT_TYPE_FLAG_ARRAY = 0x40,
00548
00551   TEK_SA_VARIANT_TYPE_FLAG_MATRIX = 0x80
00552 };
00553
00556 struct tek_sa_variant_array {
00558   int32_t length;
00559
00561   union {
00562     bool* b;
00563     uint8_t* ui8;
00564     int8_t* i8;
00565     uint16_t* ui16;
00566     int16_t* i16;
00567     uint32_t* ui32;
00568     int32_t* i32;
00569     uint64_t* ui64;
00570     int64_t* i64;
00571     float* f;
00572     double* d;
00573     tek_sa_datetime* dt;
```

```
00574     struct tek_sa_string* s;
00575     struct tek_sa_guid* guid;
00576     struct tek_sa_byte_string* bs;
00577   } data;
00578 };
00579 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_variant_array, length, 0, 0);
00580 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_variant_array, data, 4, 8);
00581
00584 struct tek_sa_variant_matrix {
00586   int32_t dimension_length;
00587
00601   int32_t* dimensions;
00602
00604   struct tek_sa_variant_array data;
00605 };
00606 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_variant_matrix, dimension_length, 0, 0);
00607 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_variant_matrix, dimensions, 4, 8);
00608
00611 struct tek_sa_variant {
00617   uint8_t type;
00618
00620   union {
00621     bool b;
00622     uint8_t ui8;
00623     int8_t i8;
00624     uint16_t ui16;
00625     int16_t i16;
00626     uint32_t ui32;
00627     int32_t i32;
00628     uint64_t ui64;
00629     int64_t i64;
00630     float f;
00631     double d;
00632     tek_sa_datetime dt;
00633     struct tek_sa_string s;
00634     struct tek_sa_guid guid;
00635     struct tek_sa_byte_string bs;
00636     struct tek_sa_variant_array array;
00637     struct tek_sa_variant_matrix matrix;
00638     struct tek_sa_complex_data complex;
00639     struct tek_sa_complex_data_array complex_array;
00640     struct tek_sa_complex_data_matrix complex_matrix;
00641   } data;
00642 };
00643 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_variant, type, 0, 0);
00644 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_variant, data, 8, 8);
00645
00647 typedef struct tek_sa_variant tek_sa_field_value;
00648
00649 /*****************************************************************************************************
00650  * Type definitions from data client to TEK
00651  *****************************************************************************************************/
00652
00656 struct tek_sa_struct_field_type_definition {
00658   char* name;
00659
00661   tek_sa_type_handle_or_type_enum type;
00662 };
00663 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_struct_field_type_definition, name, 0, 0);
00664 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_struct_field_type_definition, type, 8, 8);
00665
00669 struct tek_sa_struct_definition {
00671   char* name;
00672
00674   struct tek_sa_struct_field_type_definition* items;
00675
00677   size_t item_count;
00678 };
00679 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_struct_definition, name, 0, 0);
00680 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_struct_definition, items, 4, 8);
00681 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_struct_definition, item_count, 8, 16);
00682
00687 struct tek_sa_enum_item_definition {
00689   char* name;
00690
00692   int32_t value;
00693 };
00694 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_enum_item_definition, name, 0, 0);
00695 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_enum_item_definition, value, 4, 8);
00696
00700 struct tek_sa_enum_definition {
00702   char* name;
00703
00705   struct tek_sa_enum_item_definition* items;
00706
00708   size_t item_count;
00709 };
```

```
00710 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_enum_definition, name, 0, 0);
00711 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_enum_definition, items, 4, 8);
00712 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_enum_definition, item_count, 8, 16);
00713
00719 struct tek_sa_method_argument_description {
00721   char const* name;
00722
00724   enum tek_sa_variant_type type;
00725 };
00726 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_method_argument_description, name, 0, 0);
00727 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_method_argument_description, type, 4, 8);
00728
00729 /*****************************************************************************************************
00730  * Handles and structures for data exchange
00731  *****************************************************************************************************/
00732
00734 enum tek_sa_field_attributes {
00736   TEK_SA_FIELD_ATTRIBUTES_WRITABLE = 0x1,
00737
00739   TEK_SA_FIELD_ATTRIBUTES_READABLE = 0x2,
00740
00742   TEK_SA_FIELD_ATTRIBUTES_SUBSCRIBABLE = 0x4,
00743 };
00744
00746 typedef uint32_t tek_sa_field_handle;
00747
00749 typedef uint32_t tek_sa_event_handle;
00750
00752 typedef uint32_t tek_sa_alarm_handle;
00753
00755 typedef uint32_t tek_sa_method_handle;
00756
00762 #define TEK_SA_FIELD_HANDLE_INVALID 0
00763
00765 #define TEK_SA_EVENT_HANDLE_INVALID 0
00766
00768 #define TEK_SA_ALARM_HANDLE_INVALID 0
00769
00771 #define TEK_SA_METHOD_HANDLE_INVALID 0
00772
00786 typedef int TEK_SA_RESULT;
00787
00789 #define TEK_SA_ERR_SUCCESS 0
00790
00800 #define TEK_SA_ERR_NON_BLOCKING_IMPOSSIBLE 10
00801
00806 #define TEK_SA_ERR_OUT_OF_MEMORY 11
00807
00809 #define TEK_SA_ERR_INVALID_PARAMETER 12
00810
00821 #define TEK_SA_ERR_RETRY_LATER 0xffffffff
00822
00824 #define TEK_SA_READ_RESULT_STATUS_OK 0
00825
00827 #define TEK_SA_READ_RESULT_STATUS_NOK 1
00828
00830 #define TEK_SA_READ_RESULT_STATUS_TIMEOUT 2
00831
00834 #define TEK_SA_READ_RESULT_STATUS_INVALID_HANDLE 3
00835
00842 #define TEK_SA_BLOCK_TRANSFER_END_OF_FILE 26
00843
00851 #define TEK_SA_BLOCK_TRANSFER_ABORT 24
00854 /*****************************************************************************************************
00855  * Request and response structures
00856  *****************************************************************************************************/
00857
00859 struct tek_sa_field_write_request {
00862   tek_sa_field_handle handle;
00863
00865   tek_sa_field_value value;
00866 };
00867 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_field_write_request, handle, 0, 0);
00868 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_field_write_request, value, 8, 8);
00869
00871 struct tek_sa_write_result {
00873   TEK_SA_RESULT status;
00874
00876   tek_sa_field_handle handle;
00877 };
00878 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_write_result, status, 0, 0);
00879 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_write_result, handle, 4, 4);
00880
00883 struct tek_sa_read_result {
00885   TEK_SA_RESULT status;
00886
00888   tek_sa_field_handle handle;
```

```
00889
00896   tek_sa_field_value value;
00897 };
00898 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_read_result, status, 0, 0);
00899 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_read_result, handle, 4, 4);
00900 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_read_result, value, 8, 8);
00901
00903 struct tek_sa_event_parameter {
00905   char const* name;
00906
00908   tek_sa_field_value value;
00909 };
00910 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_event_parameter, name, 0, 0);
00911 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_event_parameter, value, 8, 8);
00912
00915 struct tek_sa_dc_event {
00922   tek_sa_datetime timestamp;
00923
00938   int16_t severity;
00939
00946   tek_sa_event_handle event_type;
00947
00954   tek_sa_field_handle source;
00955
00957   size_t number_of_parameters;
00958
00960   struct tek_sa_event_parameter* parameters;
00961 };
00962 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_dc_event, timestamp, 0, 0);
00963 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_dc_event, severity, 8, 8);
00964 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_dc_event, event_type, 12, 12);
00965 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_dc_event, source, 16, 16);
00966 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_dc_event, number_of_parameters, 20, 24);
00967 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_dc_event, parameters, 24, 32);
00968
00973 enum tek_sa_log_level_t {
00974   TEK_SA_LOG_LEVEL_TRACE = 0x0,
00975   TEK_SA_LOG_LEVEL_DEBUG = 0x1,
00976   TEK_SA_LOG_LEVEL_INFO = 0x2,
00977   TEK_SA_LOG_LEVEL_WARNING = 0x3,
00978   TEK_SA_LOG_LEVEL_ERROR = 0x4,
00979   TEK_SA_LOG_LEVEL_CRITICAL = 0x5,
00980 };
00981
00988 /**********************************************************************************************
00989  * Data client capabilities
00990  **********************************************************************************************/
00991
00996 enum tek_sa_threading_model {
01001   TEK_SA_THREADING_MODEL_SAME_THREAD = 0x0,
01002
01007   TEK_SA_THREADING_MODEL_SEQUENTIAL = 0x1,
01008
01015   TEK_SA_THREADING_MODEL_PARALLEL = 0x2,
01016 };
01017
01026 struct tek_sa_data_client_capabilities {
01036   size_t number_of_inflight_calls;
01037
01042   enum tek_sa_threading_model threading_model;
01043 };
01044 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client_capabilities, number_of_inflight_calls, 0, 0);
01045 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client_capabilities, threading_model, 4, 8);
01046
01052 struct tek_sa_data_client {
01070   TEK_SA_RESULT (*register_features)(tek_sa_data_client_handle dc);
01071
01084   TEK_SA_RESULT (*connect)(tek_sa_data_client_handle dc);
01085
01091   void (*free)(tek_sa_data_client_handle dc);
01092
01185   TEK_SA_RESULT(*read_fields)(tek_sa_data_client_handle dc, uint64_t request_id,
01186    const tek_sa_field_handle items_to_read[], size_t number_of_items,
01187    bool do_not_block);
01188
01207   TEK_SA_RESULT(*write_fields)(tek_sa_data_client_handle dc, uint64_t request_id,
01208    const struct tek_sa_field_write_request items_to_write[],
01209    size_t number_of_items, bool do_not_block);
01210
01232   TEK_SA_RESULT(*block_read)(const tek_sa_data_client_handle dc, uint64_t request_id,
01233    const char* filepath, uint64_t offset, int64_t length, bool do_not_block,
01234    int64_t* filesize);
01235
01255   TEK_SA_RESULT(*block_write)(const tek_sa_data_client_handle dc, uint64_t request_id,
01256    const char* filepath, uint64_t offset, int64_t length, bool do_not_block);
01257
01275   TEK_SA_RESULT(*subscribe)(tek_sa_data_client_handle dc, const tek_sa_field_handle
```

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      items_to_subscribe[],
01276   size_t number_of_items);
01277
01288   TEK_SA_RESULT(*unsubscribe)(tek_sa_data_client_handle dc,
01289    const tek_sa_field_handle items_to_unsubscribe[], size_t number_of_items);
01290
01314   TEK_SA_RESULT(*invoke)(const tek_sa_data_client_handle dc, const tek_sa_method_handle method,
01315    uint64_t request_id, const tek_sa_field_value parameters[],
01316    const size_t number_of_parameters);
01317
01333   void (*acknowledge_alarm)(tek_sa_data_client_handle dc,
01334                             const tek_sa_alarm_handle alarm);
01335
01345   tek_sa_data_client_handle handle;
01346
01348 };
01349 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client, register_features, 0, 0);
01350 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client, connect, 4, 8);
01351 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client, free, 8, 16);
01352 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client, read_fields, 12, 24);
01353 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client, write_fields, 16, 32);
01354 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client, block_read, 20, 40);
01355 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client, block_write, 24, 48);
01356 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client, subscribe, 28, 56);
01357 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client, unsubscribe, 32, 64);
01358 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client, invoke, 36, 72);
01359 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client, acknowledge_alarm, 40, 80);
01360 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client, handle, 44, 88);
01361
01369 struct tek_sa_data_client_plugin {
01374   void* plugin_context;
01375
01392   TEK_SA_RESULT(*data_client_new)(void* plugin_context, const struct tek_sa_configuration* config,
01393    struct tek_sa_data_client* created_client,
01394    struct tek_sa_data_client_capabilities* capabilities);
01395
01399   void (*free_context)(void* plugin_context);
01400 };
01401 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client_plugin, plugin_context, 0, 0);
01402 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client_plugin, data_client_new, 4, 8);
01403 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client_plugin, free_context, 8, 16);
01404
01417 struct tek_sa_transformation_engine {
01431   tek_sa_field_handle (*register_field)(tek_sa_data_client_handle dc,
01432                                         const char* name,
01433                                         enum tek_sa_field_attributes attributes,
01434                                         enum tek_sa_variant_type type);
01435
01449   tek_sa_method_handle (*register_method)(
01450       tek_sa_data_client_handle dc, const char* name,
01451       struct tek_sa_method_argument_description input_parameter[],
01452       size_t number_of_input_parameters,
01453       struct tek_sa_method_argument_description output_parameter[],
01454       size_t number_of_output_parameters);
01455
01468   tek_sa_event_handle (*register_event)(tek_sa_data_client_handle dc,
01469                                         const char* name);
01470
01484   tek_sa_alarm_handle (*register_alarm)(tek_sa_data_client_handle dc,
01485                                         const char* name,
01486                                         const int16_t severity,
01487                                         const tek_sa_field_handle source);
01488
01504   TEK_SA_RESULT(*register_enum_type)(tek_sa_data_client_handle dc,
01505    struct tek_sa_enum_definition const* type_definition,
01506    tek_sa_type_handle* result);
01507
01517   TEK_SA_RESULT(*register_struct_type)(tek_sa_data_client_handle dc,
01518    struct tek_sa_struct_definition const* type_definition,
01519    tek_sa_type_handle* result);
01520
01537   TEK_SA_RESULT(*post_event)(tek_sa_data_client_handle dc, struct tek_sa_dc_event const* event);
01538
01550   TEK_SA_RESULT(*set_alarm)(tek_sa_data_client_handle dc, const tek_sa_alarm_handle alarm);
01551
01560   TEK_SA_RESULT(*reset_alarm)(tek_sa_data_client_handle dc, const tek_sa_alarm_handle alarm);
01561
01584   void (*log)(tek_sa_data_client_handle source, enum tek_sa_log_level_t lvl,
01585               const char* format, va_list args);
01586
01600   tek_sa_event_handle (*get_global_event)(const char* name);
01601
01609   void (*update_capabilities)(
01610       tek_sa_data_client_handle dc,
01611       struct tek_sa_data_client_capabilities const* capabilities);
01612
01632   void (*read_progress)(tek_sa_data_client_handle dc, uint64_t request_id,
```

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01633                         uint64_t progress);
01634
01656   void (*read_result)(tek_sa_data_client_handle dc, uint64_t request_id,
01657                       TEK_SA_RESULT result,
01658                       const struct tek_sa_read_result results[],
01659                       size_t number_of_results);
01660
01668   void (*notify_change)(tek_sa_data_client_handle dc,
01669                         const struct tek_sa_read_result changes[],
01670                         size_t number_of_changes);
01671
01682   void (*write_result)(tek_sa_data_client_handle dc, uint64_t request_id,
01683                        TEK_SA_RESULT result,
01684                        const struct tek_sa_write_result results[],
01685                        size_t number_of_results);
01686
01698   void (*call_method_result)(tek_sa_data_client_handle dc, uint64_t request_id,
01699                              TEK_SA_RESULT result,
01700                              const tek_sa_field_value results[],
01701                              size_t number_of_results);
01702
01719   TEK_SA_RESULT(*block_read_data)(tek_sa_data_client_handle dc, uint64_t request_id, TEK_SA_RESULT
      result,
01720     unsigned char buffer[], size_t buffer_length);
01721
01736   TEK_SA_RESULT(*block_write_data)(tek_sa_data_client_handle dc, uint64_t request_id, unsigned char
      buffer[],
01737     size_t buffer_length, size_t* bytes_written);
01738
01747   void (*block_write_result)(tek_sa_data_client_handle dc, uint64_t request_id,
01748                              TEK_SA_RESULT result);
01749
01751 };
01752 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, register_field, 0, 0);
01753 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, register_method, 4, 8);
01754 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, register_event, 8, 16);
01755 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, register_alarm, 12, 24);
01756 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, register_enum_type, 16, 32);
01757 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, register_struct_type, 20, 40);
01758 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, post_event, 24, 48);
01759 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, set_alarm, 28, 56);
01760 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, reset_alarm, 32, 64);
01761 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, log, 36, 72);
01762 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, get_global_event, 40, 80);
01763 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, update_capabilities, 44, 88);
01764 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, read_progress, 48, 96);
01765 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, read_result, 52, 104);
01766 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, notify_change, 56, 112);
01767 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, write_result, 60, 120);
01768 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, call_method_result, 64, 128);
01769 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, block_read_data, 68, 136);
01770 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, block_write_data, 72, 144);
01771 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, block_write_result, 76, 152);
01772
01787 typedef TEK_SA_RESULT (*tek_sa_load_plugin_fn)(
01788     struct tek_sa_transformation_engine* api,
01789     const struct tek_sa_configuration* plugin_configuration,
01790     struct tek_sa_data_client_plugin* plugin);
01791
01792 #ifdef TEK_SA_DATA_CLIENT_IMPL
01793
01794 #ifdef _WIN32
01795 #define TEK_SA_API_EXPORT __declspec(dllexport) __stdcall
01796 #else
01797 #define TEK_SA_API_EXPORT __attribute__((__visibility__("default")))
01798 #endif
01799
01803 TEK_SA_RESULT TEK_SA_API_EXPORT
01804     load_plugin(struct tek_sa_transformation_engine* api,
01805             const struct tek_sa_configuration* plugin_configuration,
01806             struct tek_sa_data_client_plugin* plugin);
01807
01808 #endif
01809
01810 #ifdef __cplusplus
01811 }
01812 #endif
01813
01814 #undef TEK_SA_STRUCT_ALIGN_SELECT
01815 #undef TEK_SA_VERIFY_STRUCT_OFFSET
01816
01817 #endif /* TEK_SOUTH_API_H */
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