



Forschungsinstitut

umati Transformation Engine - API documentation

(Release Candidate, 2021-10-13)

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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](#).

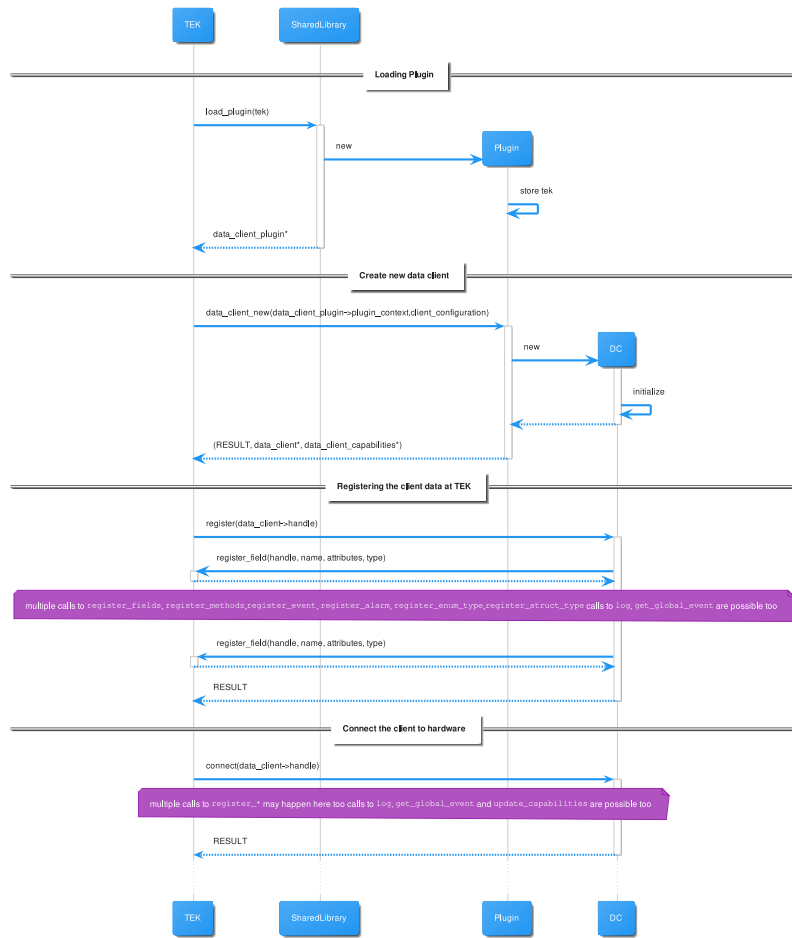
After loading the shared library the TEK calls the main initialization function with the fixed name `load_plugin` and a signature of [tek_sa_load_plugin_fn](#) . This function creates a new singleton instance of [tek_sa_data_client_plugin](#) and is expected to save the given TEK api struct.

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] mkd docs/doxybook2 output can not handle union

Todo [C, MIG] mkd docs/doxybook2 output can not handle typedefs

Todo [C, MIG] mkd docs/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:

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Chapter 6

Data Structure Index

6.1 Data Structures

Here are the data structures with brief descriptions:

tek_sa_data_client	
The interface of one instance of a data client	37
tek_sa_data_client_plugin	
Interface of the data client plugin	44
tek_sa_transformation_engine	
Interface of the Transformation Engine	46

Chapter 7

File Index

7.1 File List

Here is a list of all files with brief descriptions:

include/[south_api.h](#)

Definition of the interface between Data Clients (DC) and the Transformation Engine (TEK) . . . [59](#)

Chapter 8

Module Documentation

8.1 Transformation Engine

Data Structures

- struct [tek_sa_transformation_engine](#)
Interface of 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_data_client_configuration](#) *plugin_configuration, struct [tek_sa_data_client_plugin](#) *plugin, struct [tek_sa_configuration](#) *tek_configuration)
Signature for the load plugin function.

Enumerations

- enum [tek_sa_threading_model](#) { [TEK_SA_THREADING_MODEL_SAME_THREAD](#) = 0x0 , [TEK_SA_THREADING_MODEL_SAME_THREAD](#) = 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 [1024](#) of file [south_api.h](#).

Data Fields

size_t	number_of_inflight_calls	<p>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.</p> <p>Remarks</p> <p>This information may be dependent on the physical device and therefore available only after the connection was established.</p>
enum tek_sa_threading_model	threading_model	<p>Requirements for the thread calling any communication function in the data client API</p>

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_data_client_configuration *plugin_configuration, struct tek_sa_data_client_plugin
*plugin, struct tek_sa_configuration *tek_configuration)
```

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

<i>api</i>	The TEK api.
<i>plugin_configuration</i>	Additional configuration files, e.g. licensing information, for the plugin itself.
<i>plugin</i>	The result of the initialized plugin.
<i>tek_configuration</i>	global configuration of properties used for data_clients

Returns

Success or failure code.

Definition at line 1809 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	<p>DLL is thread safe, multiple parallel calls are allowed.</p> <p>Remarks</p> <p>If the number of parallel tasks in the data client is reached, the API call may return <code>ASYNC_RESULT_RETRY_LATER</code>.</p>

Definition at line 994 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_data_client_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_configuration](#)
Configuration struct that contains generic properties and settings for TEK instance. [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...](#)*

Macros

- #define [TEK_SA_ERR_UNSPECIFIED](#) 1000
- unspecified error to be used when no more specific error is available.*

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_T`
= 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.

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_data_client_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_configuration

Configuration struct that contains generic properties and settings for TEK instance.

Definition at line 276 of file [south_api.h](#).

Data Fields

uint32_t	request_timeout_ms	generic definition for timeouts with linkage to communication to connected dataclients (e.g. requests), value is given in milli-seconds
----------	--------------------	---

8.3.2.4 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, guides, 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 311 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.

8.3.2.5 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 336 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

8.3.2.6 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 354 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.

8.3.2.7 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 379 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 <code>data</code> field. This is needed because the encoded length may differ for items of the same type.
unsigned char *	data	The bytes of the serialized value. 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/ .

8.3.2.8 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 409 of file [south_api.h](#).

Data Fields

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

8.3.2.9 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 438 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.

8.3.2.10 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 463 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. 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] 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.

8.3.2.11 struct tek_sa_variant_array

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

Definition at line 566 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.

8.3.2.12 struct tek_sa_variant_matrix

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

Definition at line 594 of file [south_api.h](#).

Data Fields

int32_t	dimension_length	The number of array dimensions.
int32_t *	dimensions	The array dimensions. 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] 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.

8.3.2.13 struct tek_sa_variant

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

Definition at line 621 of file [south_api.h](#).

Data Fields

uint8_t	type	The type of the value. Must be one of the values described in tek_sa_variant_type .
union tek_sa_variant.data	data	The value.

8.3.2.14 struct tek_sa_struct_field_type_definition

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

Definition at line 666 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.

8.3.2.15 struct tek_sa_struct_definition

The type definition of a user defined record type.

Definition at line 679 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.

8.3.2.16 struct tek_sa_enum_item_definition

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

Definition at line [697](#) 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.

8.3.2.17 struct tek_sa_enum_definition

The type definition of a user defined enum type.

Definition at line [710](#) 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.

8.3.2.18 struct tek_sa_method_argument_description

The description of a method parameter.

See [tek_sa_transformation_engine::register_method](#)

Definition at line [729](#) 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.

8.3.2.19 struct tek_sa_field_write_request

Structure to encapsulate the parameters of a write field request.

Definition at line 857 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.

8.3.2.20 struct tek_sa_write_result

Structure to encapsulate the result of a write field request.

Definition at line 869 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.

8.3.2.21 struct tek_sa_read_result

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

Definition at line 881 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. Attention Must not be accessed if the <code>status</code> is not TEK_SA_ERR_SUCCESS

8.3.2.22 struct tek_sa_event_parameter

Structure to encapsulate an event parameter.

Definition at line 901 of file [south_api.h](#).

Data Fields

<code>char const *</code>	name	The name of the parameter.
tek_sa_field_value	value	The value of the event parameter.

8.3.2.23 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 913 of file [south_api.h](#).

Data Fields

tek_sa_datetime	timestamp	<p>The Timestamp of the event.</p> <p>Remarks</p> <p>This should be the a value as close as possible to the actual occurrence of the event.</p>
int16_t	severity	<p>The severity level of the event.</p> <p>The severity is defined as in https://reference.opcfoundation.org/v104/Core/docs/Part5/6.4.2/ which is cited here:</p> <p>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.</p>
tek_sa_event_handle	event_type	<p>The event type handle as returned by the call to tek_sa_transformation_engine::register_event.</p> <p>Attention</p> <p>This field must not be TEK_SA_EVENT_HANDLE_INVALID</p>
tek_sa_field_handle	source	<p>The handle of the source of the event.</p> <p>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.</p>
size_t	number_of_parameters	The number of event parameters.
struct tek_sa_event_parameter *	parameters	The event parameters.

8.3.2.24 union tek_sa_variant_array.data

The array values.

Definition at line 571 of file [south_api.h](#).

Data Fields

bool *	b	
--------	---	--

Data Fields

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	

8.3.2.25 union [tek_sa_variant.data](#)

The value.

Definition at line 630 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_ERR_SUCCESS

```
#define TEK_SA_ERR_SUCCESS 0
```

An operation was completed successfully.

Definition at line 781 of file [south_api.h](#).

8.3.3.2 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 792 of file [south_api.h](#).

8.3.3.3 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 798 of file [south_api.h](#).

8.3.3.4 TEK_SA_ERR_INVALID_PARAMETER

```
#define TEK_SA_ERR_INVALID_PARAMETER 12
```

The parameters passed to the function are invalid.

Definition at line 801 of file [south_api.h](#).

8.3.3.5 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 813 of file [south_api.h](#).

8.3.3.6 TEK_SA_READ_RESULT_STATUS_OK

```
#define TEK_SA_READ_RESULT_STATUS_OK 0
```

A read operation completed successfully.

Definition at line 816 of file [south_api.h](#).

8.3.3.7 TEK_SA_READ_RESULT_STATUS_NOK

```
#define TEK_SA_READ_RESULT_STATUS_NOK 1
```

A read operation failed.

Definition at line 819 of file [south_api.h](#).

8.3.3.8 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 822 of file [south_api.h](#).

8.3.3.9 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 826 of file [south_api.h](#).

8.3.3.10 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 834 of file [south_api.h](#).

8.3.3.11 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_data](#) callback.

Definition at line 843 of file [south_api.h](#).

8.3.3.12 TEK_SA_ERR_UNSPECIFIED

```
#define TEK_SA_ERR_UNSPECIFIED 1000
```

unspecified error to be used when no more specific error is available.

Definition at line 850 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 295 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 301 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 370 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 657 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 756 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 759 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 762 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 765 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 778 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.

Enumerator

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 502 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 744 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	

Enumerator

TEK_SA_LOG_LEVEL_INFO	
TEK_SA_LOG_LEVEL_WARNING	
TEK_SA_LOG_LEVEL_ERROR	
TEK_SA_LOG_LEVEL_CRITICAL	

Definition at line 971 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.
- `TEK_SA_RESULT(* 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 1050 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

<i>dc</i>	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 1068 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 its 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 1082 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 1089 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 retrieve the values is larger than half the global timeout value a data client must call the [vde_sa_tek_ap::read_progress](#) callback function.

Parameters

<i>dc</i>	The handle of the data client as returned from tek_sa_data_client_plugin::data_client_new .
<i>request_id</i>	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 .
<i>items_to_read</i>	An array of field handles which describes the values the data client should read. See also function tek_sa_transformation_engine::register_field .
<i>number_of_items</i>	The number of handles in the parameter <code>items_to_read</code> .
<i>do_not_block</i>	A boolean flag that, when set to <i>true</i> , 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`

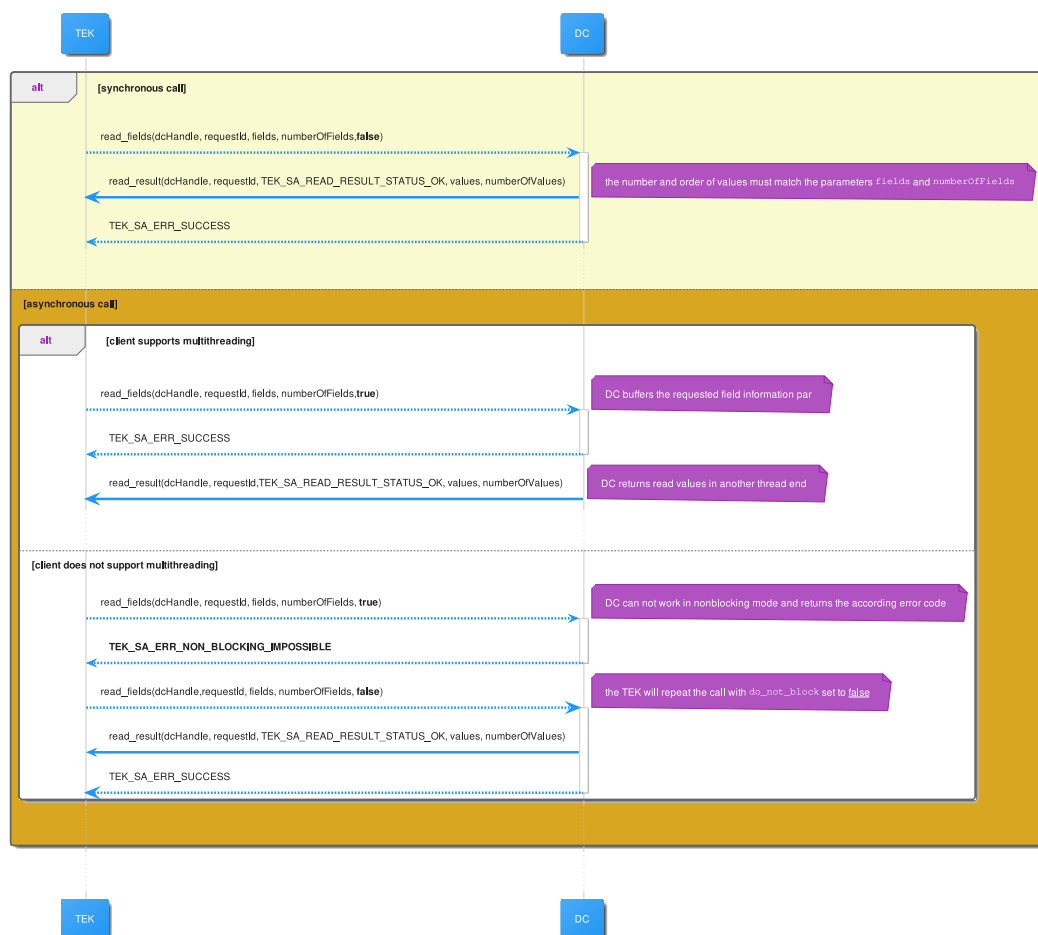


Figure 9.1 Possible call sequences

Definition at line 1183 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

<i>dc</i>	The handle of the data client as returned from tek_sa_data_client_plugin::data_client_new .
<i>request_id</i>	A unique request identifier which is created by the TEK and must be passed to call to tek_sa_transformation_engine::write_result .
<i>items_to_write</i>	An array of field handles and their values which describes the values the data client should write.
<i>number_of_items</i>	The number of handles in the parameter <i>items_to_write</i> .
<i>do_not_block</i>	A boolean flag that, when set to <i>true</i> , 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 1205 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

<i>dc</i>	The data client handle
<i>request_id</i>	The request id for the TEK API callbacks
<i>filepath</i>	The file or address of the block to be read. The format is data client specific. The pointer must be in utf-8.
<i>offset</i>	The offset in the data
<i>length</i>	A specific length, or -1 for the whole data
<i>do_not_block</i>	See Usage in read_fields
<i>filesize</i>	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 1230 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

<i>dc</i>	The handle of the data client as returned from tek_sa_data_client_plugin::data_client_new .
<i>request_id</i>	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 .
<i>offset</i>	The offset in the data
<i>length</i>	A specific length, or -1 for the whole data
<i>do_not_block</i>	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 1253 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

<i>dc</i>	The handle of the data client as returned from tek_sa_data_client_plugin::data_client_new .
<i>items_to_subscribe</i>	The fields for which change events will be received.
<i>number_of_items</i>	The number of elements in the <i>items_to_subscribe</i> 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 1273 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

<i>dc</i>	The handle of the data client as returned from tek_sa_data_client_plugin::data_client_new .
<i>items_to_unsubscribe</i>	The fields for which no more change events will be received.
<i>number_of_items</i>	The number of elements in the <code>items_to_unsubscribe</code> parameter.

Definition at line 1286 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

<i>dc</i>	The handle of the data client as returned from tek_sa_data_client_plugin::data_client_new .
<i>method</i>	The method handle which is returned from the <code>tek_sa_data_transformation_engine::register_method</code> method.
<i>request_id</i>	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 .
<i>parameters</i>	The parameters of the method. Number and type must match the method registration.
<i>number_of_parameters</i>	The number of parameters in the <code>parameters</code> array.

The outcome of the message call is returned in the [tek_sa_transformation_engine::call_method_result](#) callback.

Definition at line 1312 of file [south_api.h](#).

9.1.2.11 acknowledge_alarm

```
TEK_SA_RESULT(* 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

<i>dc</i>	The handle of the data client as returned from tek_sa_data_client_plugin::data_client_new .
<i>alarm</i>	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 1331 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 1343 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_data_client_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 1367 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 1372 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\_data\_client\_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`.

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

Parameters

<i>plugin_context</i>	
<i>config</i>	
<i>created_client</i>	
<i>capabilities</i>	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 1390 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 1397 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 of the Transformation Engine.

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

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

- [TEK_SA_RESULT](#)(* [register_field](#))([tek_sa_data_client_handle](#) dc, const char *name, enum [tek_sa_field_attributes](#) attributes, enum [tek_sa_variant_type](#) type, [tek_sa_field_handle](#) *new_field_handle)
Registers a new field of a data client with a name inside the TEK.
- [TEK_SA_RESULT](#)(* [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[], uint32_t number_of_output_parameters, [tek_sa_method_handle](#) *new_method_handle)
Registers a new method at the TEK.
- [TEK_SA_RESULT](#)(* [register_event](#))([tek_sa_data_client_handle](#) dc, const char *name, [tek_sa_event_handle](#) *new_event_handle)
Registers a new Event that a data client might raise.
- [TEK_SA_RESULT](#)(* [register_alarm](#))([tek_sa_data_client_handle](#) dc, const char *name, const int16_t severity, const [tek_sa_field_handle](#) source, [tek_sa_alarm_handle](#) *new_alarm_handle)
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](#) *new_type_handle)
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](#) *new_type_handle)

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

- `TEK_SA_RESULT(* 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.
- `TEK_SA_RESULT(* 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

- `TEK_SA_RESULT(* 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.
- `TEK_SA_RESULT(* 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.
- `TEK_SA_RESULT(* 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.
- `TEK_SA_RESULT(* 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.
- `TEK_SA_RESULT(* 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.
- `TEK_SA_RESULT(* 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 of 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 1415 of file [south_api.h](#).

9.3.2 Field Documentation

9.3.2.1 register_field

```
TEK_SA_RESULT(* 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,
tek_sa_field_handle *new_field_handle)
```

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

Parameters

<i>dc</i>	The data client that registers at the TEK.
<i>name</i>	The name of the field. The data client decides the name.
<i>attributes</i>	The attributes of the field, e.g. is writeable.
<i>type</i>	The data type of the field.
<i>new_field_handle</i>	result of registration, only valid when method returns TEK_SA_ERR_SUCCESS.

Returns

TEK_SA_ERR_SUCCESS or error code when registration failed (e.g. duplicate registration, empty name...).

Definition at line 1433 of file [south_api.h](#).

9.3.2.2 register_method

```
TEK_SA_RESULT(* 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[], uint32_t
number_of_output_parameters, tek_sa_method_handle *new_method_handle)
```

Registers a new method at the TEK.

Parameters

<i>dc</i>	The data client that registers at the TEK.
<i>name</i>	The name of the method.
tek_sa_method_argument_description	The description of the method input arguments.
<i>number_of_input_parameters</i>	The number of input parameters.
tek_sa_method_argument_description	The description of the method output arguments.
<i>number_of_output_parameters</i>	The number of output parameters.
<i>new_method_handle</i>	result of registration, only valid when method returns TEK_SA_ERR_SUCCESS.

Returns

TEK_SA_ERR_SUCCESS or error code when registration failed (e.g. duplicate registration, empty name...).

Definition at line 1456 of file [south_api.h](#).

9.3.2.3 register_event

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

Registers a new Event that a data client might raise.

Parameters

<i>dc</i>	The data client that registers at the TEK.
<i>name</i>	The name of the event. Must be unique within all events registered from this dc.
<i>new_event_handle</i>	result of registration, only valid when method returns TEK_SA_ERR_SUCCESS.

Returns

TEK_SA_ERR_SUCCESS or error code when 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 1479 of file [south_api.h](#).

9.3.2.4 register_alarm

```
TEK_SA_RESULT(* 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, tek_sa_alarm_handle  
*new_alarm_handle)
```

Registers an alarm at the TEK.

Parameters

<i>dc</i>	The data client that registers at the TEK.
<i>name</i>	The name of the new alarm, must be unique within all alarms registered for this data client.
<i>severity</i>	The alarm severity level.
<i>source</i>	field the alarm relates to, the same field can be used for multiple alarms.
<i>new_alarm_handle</i>	result of registration only valid when method returns TEK_SA_ERR_SUCCESS.

Returns

TEK_SA_ERR_SUCCESS or error code when registration failed (e.g. duplicate registration, empty name...).

Definition at line 1498 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 *new_type_handle)
```

Register a user defined enum type.

Parameters

<i>dc</i>	The data client that registers at the TEK.
tek_sa_enum_definition	The definition of the enumeration.
<i>result</i>	A tek_sa_type_handle associated to the registered enum.
<i>new_type_handle</i>	result of registration, only valid when method returns TEK_SA_ERR_SUCCESS.

Returns

TEK_SA_ERR_SUCCESS or error code when registration failed (e.g. duplicate registration, empty name...).

Definition at line 1522 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 *new_type_handle)
```

Register a user defined struct type.

Parameters

<i>dc</i>	The data client that registers at the TEK.
tek_sa_struct_definition	The definition of the struct.
<i>new_type_handle</i>	result of registration call when successful, only valid when method returns TEK_SA_ERR_SUCCESS.

Returns

indicator whether the type definition was successfully registered

Definition at line 1536 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

<i>dc</i>	Handle of the data client which sends the event.
<i>event</i>	A event structure. See dc_event .

Returns

indicator whether the event was successfully posted or not

Definition at line [1556](#) 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

<i>dc</i>	Handle of the data client that sets the alarm.
<i>alarm</i>	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 [1569](#) 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

<i>dc</i>	Handle of the data client that clears/resets the alarm.
<i>alarm</i>	Handle of the alarm to be cleared/reset.

Returns

indicator whether resetting the alarm was successful or not

Definition at line 1579 of file [south_api.h](#).

9.3.2.10 log

```
TEK_SA_RESULT(* 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

<i>data_client_handle</i>	The data client that logs a message.
<i>lvl</i>	The logging level.
<i>format</i>	The message format string. Format must be compatible to <code>printf</code> .
<i>args</i>	A <code>va_list</code> that contains all the arguments for the format string.

Returns

log result status code; can be ignored normally or used for debugging.

Definition at line 1605 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

<i>name</i>	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 1621 of file [south_api.h](#).

9.3.2.12 update_capabilities

```
TEK_SA_RESULT(* 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

<i>dc</i>	Handle of the data client that informs about the change of its capabilities.
<i>tek_sa_data_client_capabilities</i>	The updated client capabilities.

Returns

(void)

Definition at line 1630 of file [south_api.h](#).

9.3.2.13 read_progress

```
TEK_SA_RESULT(* 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

<i>dc</i>	Handle of the data client that is the source of the call
<i>request_id</i>	id of request to data client which triggered the call back
<i>progress</i>	?? (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 1653 of file [south_api.h](#).

9.3.2.14 read_result

```
TEK_SA_RESULT(* 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

<i>dc</i>	Handle of the data client that is the source of the call
<i>request_id</i>	id of request to data client that triggered the call back
<i>result</i>	status code for read request
<i>results</i>	read values
<i>number_of_results</i>	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 1677 of file [south_api.h](#).

9.3.2.15 notify_change

```
TEK_SA_RESULT(* 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

<i>dc</i>	Handle of the data client that is the source of the change
<i>changes</i>	changed field values
<i>number_of_changes</i>	length of changes array

Definition at line 1689 of file [south_api.h](#).

9.3.2.16 write_result

```
TEK_SA_RESULT(* 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

<i>dc</i>	Handle of the data client data was written to
<i>request_id</i>	id of write request to data client that triggered the call back
<i>result</i>	overall result of write operation
<i>results</i>	write results for each written field
<i>number_of_results</i>	length of results array

Definition at line 1703 of file [south_api.h](#).

9.3.2.17 call_method_result

```
TEK_SA_RESULT(* 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

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

Definition at line 1719 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

<i>dc</i>	The data client handle.
-----------	-------------------------

Parameters

<i>request_id</i>	The request id of the block transfer.
<i>result</i>	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.
<i>buffer</i>	The current chunk of the file. The TEK must copy the data into it's own process.
<i>buffer_length</i>	The length of the chunk.

Returns

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

Definition at line 1740 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

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

Returns

Success or failure code.

Definition at line 1757 of file [south_api.h](#).

9.3.2.20 block_write_result

```
TEK_SA_RESULT(* 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

<i>dc</i>	The data client handle.
<i>request↔ _id</i>	The request id of the block transfer.
<i>result</i>	The final result.

Definition at line 1768 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_data_client_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_configuration](#)
Configuration struct that contains generic properties and settings for TEK instance. [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 of 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"
 - #define [TEK_SA_ERR_UNSPECIFIED](#) 1000
- unspecified error to be used when no more specific error is available.*

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_data_client_configuration](#) *plugin_configuration, struct [tek_sa_data_client_plugin](#) *plugin, struct [tek_sa_configuration](#) *tek_configuration)
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_T](#) = 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_data_client_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_data_client_configuration, config, 0, 0);
00270 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client_configuration, additional_files, 4, 8);
00271 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client_configuration, additional_files_count, 8, 16);
00272
00276 struct tek_sa_configuration {
00278     uint32_t request_timeout_ms;
00279 };
00280
00281 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_configuration, request_timeout_ms, 0, 0);
00282
00283 /*****
00284  * Built-in type definitions and variant
00285  *****/
00286
00295 typedef int64_t tek_sa_type_handle;
00296
00301 typedef int64_t tek_sa_type_handle_or_type_enum;
00302
00311 struct tek_sa_guid {
00313     uint32_t data1;
00314
00316     uint16_t data2;
00317
00319     uint16_t data3;
00320
00322     uint8_t data4[8];
00323 };
00324 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_guid, data1, 0, 0);
00325 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_guid, data2, 4, 4);
00326 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_guid, data3, 6, 6);
00327 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_guid, data4, 8, 8);
00328
00336 struct tek_sa_byte_string {
00338     int32_t length;
00339
00341     unsigned char* data;
00342 };
00343 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_byte_string, length, 0, 0);
00344 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_byte_string, data, 4, 8);
00345
00354 struct tek_sa_string {
00356     int32_t length;
00357
00359     unsigned char* data;
00360 };
00361 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_string, length, 0, 0);
00362 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_string, data, 4, 8);
00363
00370 typedef int64_t tek_sa_datetime;
00371
00379 struct tek_sa_complex_data {
00381     tek_sa_type_handle type;
00382
00389     uint32_t data_length;
00390
00397     unsigned char* data;
00398 };
00399 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_complex_data, type, 0, 0);

```

```

00400 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_complex_data, data_length, 8, 8);
00401 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_complex_data, data, 12, 16);
00402
00409 struct tek_sa_complex_data_array_item {
00417     uint32_t data_length;
00418
00424     unsigned char* data;
00425 };
00426 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_complex_data_array_item, data_length, 0, 0);
00427 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_complex_data_array_item, data, 4, 8);
00428
00438 struct tek_sa_complex_data_array {
00440     tek_sa_type_handle type;
00441
00443     size_t number_of_items;
00444
00447     struct tek_sa_complex_data_array_item* data;
00448 };
00449
00450 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_complex_data_array, type, 0, 0);
00451 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_complex_data_array, number_of_items, 8, 8);
00452 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_complex_data_array, data, 12, 16);
00453
00463 struct tek_sa_complex_data_matrix {
00465     tek_sa_type_handle type;
00466
00468     int32_t dimension_length;
00469
00484     int32_t* dimensions;
00485
00488     struct tek_sa_complex_data_array_item* data;
00489 };
00490 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_complex_data_matrix, type, 0, 0);
00491 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_complex_data_matrix, dimension_length, 8, 8);
00492 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_complex_data_matrix, dimensions, 12, 16);
00493 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_complex_data_matrix, data, 16, 24);
00494
00502 enum tek_sa_variant_type {
00504     TEK_SA_VARIANT_TYPE_NULL = 0x0,
00505
00507     TEK_SA_VARIANT_TYPE_BOOL = 0x1,
00508
00510     TEK_SA_VARIANT_TYPE_UINT8_T = 0x2,
00511
00513     TEK_SA_VARIANT_TYPE_INT8_T = 0x3,
00514
00516     TEK_SA_VARIANT_TYPE_UINT16_T = 0x4,
00517
00519     TEK_SA_VARIANT_TYPE_INT16_T = 0x5,
00520
00522     TEK_SA_VARIANT_TYPE_UINT32_T = 0x6,
00523
00525     TEK_SA_VARIANT_TYPE_INT32_T = 0x7,
00526
00528     TEK_SA_VARIANT_TYPE_UINT64_T = 0x8,
00529
00531     TEK_SA_VARIANT_TYPE_INT64_T = 0x9,
00532
00534     TEK_SA_VARIANT_TYPE_FLOAT = 0xa,
00535
00537     TEK_SA_VARIANT_TYPE_DOUBLE = 0xb,
00538
00540     TEK_SA_VARIANT_TYPE_DATETIME = 0xc,
00541
00543     TEK_SA_VARIANT_TYPE_STRING = 0xd,
00544
00546     TEK_SA_VARIANT_TYPE_GUID = 0xe,
00547
00549     TEK_SA_VARIANT_TYPE_BYTE_STRING = 0xf,
00550
00553     TEK_SA_VARIANT_TYPE_COMPLEX = 0x20,
00554
00557     TEK_SA_VARIANT_TYPE_FLAG_ARRAY = 0x40,
00558
00561     TEK_SA_VARIANT_TYPE_FLAG_MATRIX = 0x80
00562 };
00563
00566 struct tek_sa_variant_array {
00568     int32_t length;
00569
00571     union {
00572         bool* b;
00573         uint8_t* ui8;
00574         int8_t* i8;
00575         uint16_t* ui16;
00576         int16_t* i16;
00577         uint32_t* ui32;

```

```

00578     int32_t* i32;
00579     uint64_t* ui64;
00580     int64_t* i64;
00581     float* f;
00582     double* d;
00583     tek_sa_datetime* dt;
00584     struct tek_sa_string* s;
00585     struct tek_sa_guid* guid;
00586     struct tek_sa_byte_string* bs;
00587 } data;
00588 };
00589 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_variant_array, length, 0, 0);
00590 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_variant_array, data, 4, 8);
00591
00594 struct tek_sa_variant_matrix {
00595     int32_t dimension_length;
00596
00597     int32_t* dimensions;
00612
00614     struct tek_sa_variant_array data;
00615 };
00616 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_variant_matrix, dimension_length, 0, 0);
00617 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_variant_matrix, dimensions, 4, 8);
00618
00621 struct tek_sa_variant {
00627     uint8_t type;
00628
00630     union {
00631         bool b;
00632         uint8_t ui8;
00633         int8_t i8;
00634         uint16_t ui16;
00635         int16_t i16;
00636         uint32_t ui32;
00637         int32_t i32;
00638         uint64_t ui64;
00639         int64_t i64;
00640         float f;
00641         double d;
00642         tek_sa_datetime dt;
00643         struct tek_sa_string s;
00644         struct tek_sa_guid guid;
00645         struct tek_sa_byte_string bs;
00646         struct tek_sa_variant_array array;
00647         struct tek_sa_variant_matrix matrix;
00648         struct tek_sa_complex_data complex;
00649         struct tek_sa_complex_data_array complex_array;
00650         struct tek_sa_complex_data_matrix complex_matrix;
00651     } data;
00652 };
00653 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_variant, type, 0, 0);
00654 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_variant, data, 8, 8);
00655
00657 typedef struct tek_sa_variant tek_sa_field_value;
00658
00659 /*****
00660  * Type definitions from data client to TEK
00661  *****/
00662
00666 struct tek_sa_struct_field_type_definition {
00668     char* name;
00669
00671     tek_sa_type_handle_or_type_enum type;
00672 };
00673 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_struct_field_type_definition, name, 0, 0);
00674 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_struct_field_type_definition, type, 8, 8);
00675
00679 struct tek_sa_struct_definition {
00681     char* name;
00682
00684     struct tek_sa_struct_field_type_definition* items;
00685
00687     size_t item_count;
00688 };
00689 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_struct_definition, name, 0, 0);
00690 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_struct_definition, items, 4, 8);
00691 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_struct_definition, item_count, 8, 16);
00692
00697 struct tek_sa_enum_item_definition {
00699     char* name;
00700
00702     int32_t value;
00703 };
00704 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_enum_item_definition, name, 0, 0);
00705 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_enum_item_definition, value, 4, 8);
00706
00710 struct tek_sa_enum_definition {

```



```

00712     char* name;
00713
00715     struct tek_sa_enum_item_definition* items;
00716
00718     size_t item_count;
00719 };
00720 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_enum_definition, name, 0, 0);
00721 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_enum_definition, items, 4, 8);
00722 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_enum_definition, item_count, 8, 16);
00723
00729 struct tek_sa_method_argument_description {
00731     char const* name;
00732
00734     enum tek_sa_variant_type type;
00735 };
00736 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_method_argument_description, name, 0, 0);
00737 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_method_argument_description, type, 4, 8);
00738
00739 /*****
00740  * Handles and structures for data exchange
00741  *****/
00742
00744 enum tek_sa_field_attributes {
00746     TEK_SA_FIELD_ATTRIBUTES_WRITABLE = 0x1,
00747
00749     TEK_SA_FIELD_ATTRIBUTES_READABLE = 0x2,
00750
00752     TEK_SA_FIELD_ATTRIBUTES_SUBSCRIBABLE = 0x4,
00753 };
00754
00756 typedef uint32_t tek_sa_field_handle;
00757
00759 typedef uint32_t tek_sa_event_handle;
00760
00762 typedef uint32_t tek_sa_alarm_handle;
00763
00765 typedef uint32_t tek_sa_method_handle;
00766
00778 typedef int TEK_SA_RESULT;
00779
00781 #define TEK_SA_ERR_SUCCESS 0
00782
00792 #define TEK_SA_ERR_NON_BLOCKING_IMPOSSIBLE 10
00793
00798 #define TEK_SA_ERR_OUT_OF_MEMORY 11
00799
00801 #define TEK_SA_ERR_INVALID_PARAMETER 12
00802
00813 #define TEK_SA_ERR_RETRY_LATER 0xffffffff
00814
00816 #define TEK_SA_READ_RESULT_STATUS_OK 0
00817
00819 #define TEK_SA_READ_RESULT_STATUS_NOK 1
00820
00822 #define TEK_SA_READ_RESULT_STATUS_TIMEOUT 2
00823
00826 #define TEK_SA_READ_RESULT_STATUS_INVALID_HANDLE 3
00827
00834 #define TEK_SA_BLOCK_TRANSFER_END_OF_FILE 26
00835
00843 #define TEK_SA_BLOCK_TRANSFER_ABORT 24
00850 #define TEK_SA_ERR_UNSPECIFIED 1000
00851
00852 /*****
00853  * Request and response structures
00854  *****/
00855
00857 struct tek_sa_field_write_request {
00860     tek_sa_field_handle handle;
00861
00863     tek_sa_field_value value;
00864 };
00865 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_field_write_request, handle, 0, 0);
00866 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_field_write_request, value, 8, 8);
00867
00869 struct tek_sa_write_result {
00871     TEK_SA_RESULT status;
00872
00874     tek_sa_field_handle handle;
00875 };
00876 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_write_result, status, 0, 0);
00877 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_write_result, handle, 4, 4);
00878
00881 struct tek_sa_read_result {
00883     TEK_SA_RESULT status;
00884
00886     tek_sa_field_handle handle;

```

```

00887
00894     tek_sa_field_value value;
00895 };
00896 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_read_result, status, 0, 0);
00897 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_read_result, handle, 4, 4);
00898 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_read_result, value, 8, 8);
00899
00901 struct tek_sa_event_parameter {
00902     char const* name;
00903
00904     tek_sa_field_value value;
00905 };
00906 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_event_parameter, name, 0, 0);
00907 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_event_parameter, value, 8, 8);
00908
00910 struct tek_sa_dc_event {
00911     tek_sa_datetime timestamp;
00912
00913     int16_t severity;
00914
00915     tek_sa_event_handle event_type;
00916
00917     tek_sa_field_handle source;
00918
00919     size_t number_of_parameters;
00920
00921     struct tek_sa_event_parameter* parameters;
00922 };
00923 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_dc_event, timestamp, 0, 0);
00924 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_dc_event, severity, 8, 8);
00925 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_dc_event, event_type, 12, 12);
00926 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_dc_event, source, 16, 16);
00927 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_dc_event, number_of_parameters, 20, 24);
00928 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_dc_event, parameters, 24, 32);
00929
00931 enum tek_sa_log_level_t {
00932     TEK_SA_LOG_LEVEL_TRACE = 0x0,
00933     TEK_SA_LOG_LEVEL_DEBUG = 0x1,
00934     TEK_SA_LOG_LEVEL_INFO = 0x2,
00935     TEK_SA_LOG_LEVEL_WARNING = 0x3,
00936     TEK_SA_LOG_LEVEL_ERROR = 0x4,
00937     TEK_SA_LOG_LEVEL_CRITICAL = 0x5,
00938 };
00939
00940 /*****
00941  * Data client capabilities
00942  *****/
00943
00944 enum tek_sa_threading_model {
00945     TEK_SA_THREADING_MODEL_SAME_THREAD = 0x0,
00946
00947     TEK_SA_THREADING_MODEL_SEQUENTIAL = 0x1,
00948
00949     TEK_SA_THREADING_MODEL_PARALLEL = 0x2,
00950 };
00951
00952 struct tek_sa_data_client_capabilities {
00953     size_t number_of_inflight_calls;
00954
00955     enum tek_sa_threading_model threading_model;
00956 };
00957 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client_capabilities, number_of_inflight_calls, 0, 0);
00958 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client_capabilities, threading_model, 4, 8);
00959
00960 struct tek_sa_data_client {
00961     TEK_SA_RESULT (*register_features)(tek_sa_data_client_handle dc);
00962
00963     TEK_SA_RESULT (*connect)(tek_sa_data_client_handle dc);
00964
00965     void (*free)(tek_sa_data_client_handle dc);
00966
00967     TEK_SA_RESULT(*read_fields)(tek_sa_data_client_handle dc, uint64_t request_id,
00968         const tek_sa_field_handle items_to_read[], size_t number_of_items,
00969         bool do_not_block);
00970
00971     TEK_SA_RESULT(*write_fields)(tek_sa_data_client_handle dc, uint64_t request_id,
00972         const struct tek_sa_field_write_request items_to_write[],
00973         size_t number_of_items, bool do_not_block);
00974
00975     TEK_SA_RESULT(*block_read)(const tek_sa_data_client_handle dc, uint64_t request_id,
00976         const char* filepath, uint64_t offset, int64_t length, bool do_not_block,
00977         int64_t* filesize);
00978
00979     TEK_SA_RESULT(*block_write)(const tek_sa_data_client_handle dc, uint64_t request_id,
00980         const char* filepath, uint64_t offset, int64_t length, bool do_not_block);
00981
00982     TEK_SA_RESULT(*subscribe)(tek_sa_data_client_handle dc, const tek_sa_field_handle

```

```

        items_to_subscribe[],
01274         size_t number_of_items);
01275
01286 TEK_SA_RESULT(*unsubscribe)(tek_sa_data_client_handle dc,
01287     const tek_sa_field_handle items_to_unsubscribe[], size_t number_of_items);
01288
01312 TEK_SA_RESULT(*invoke)(const tek_sa_data_client_handle dc, const tek_sa_method_handle method,
01313     uint64_t request_id, const tek_sa_field_value parameters[],
01314     const size_t number_of_parameters);
01315
01331 TEK_SA_RESULT (*acknowledge_alarm)(tek_sa_data_client_handle dc,
01332     const tek_sa_alarm_handle alarm);
01333
01343 tek_sa_data_client_handle handle;
01344
01346 };
01347 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client, register_features, 0, 0);
01348 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client, connect, 4, 8);
01349 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client, free, 8, 16);
01350 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client, read_fields, 12, 24);
01351 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client, write_fields, 16, 32);
01352 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client, block_read, 20, 40);
01353 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client, block_write, 24, 48);
01354 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client, subscribe, 28, 56);
01355 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client, unsubscribe, 32, 64);
01356 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client, invoke, 36, 72);
01357 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client, acknowledge_alarm, 40, 80);
01358 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client, handle, 44, 88);
01359
01367 struct tek_sa_data_client_plugin {
01372     void* plugin_context;
01373
01390 TEK_SA_RESULT(*data_client_new)(void* plugin_context, const struct tek_sa_data_client_configuration*
    config,
01391     struct tek_sa_data_client* created_client,
01392     struct tek_sa_data_client_capabilities* capabilities);
01393
01397 void (*free_context)(void* plugin_context);
01398 };
01399 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client_plugin, plugin_context, 0, 0);
01400 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client_plugin, data_client_new, 4, 8);
01401 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_data_client_plugin, free_context, 8, 16);
01402
01415 struct tek_sa_transformation_engine {
01433 TEK_SA_RESULT (*register_field)(tek_sa_data_client_handle dc,
01434     const char* name,
01435     enum tek_sa_field_attributes attributes,
01436     enum tek_sa_variant_type type,
01437     tek_sa_field_handle* new_field_handle);
01438
01456 TEK_SA_RESULT (*register_method)(
01457     tek_sa_data_client_handle dc, const char* name,
01458     struct tek_sa_method_argument_description input_parameter[],
01459     size_t number_of_input_parameters,
01460     struct tek_sa_method_argument_description output_parameter[],
01461     uint32_t number_of_output_parameters,
01462     tek_sa_method_handle* new_method_handle);
01463
01479 TEK_SA_RESULT (*register_event)(tek_sa_data_client_handle dc,
01480     const char* name,
01481     tek_sa_event_handle* new_event_handle);
01482
01498 TEK_SA_RESULT (*register_alarm)(tek_sa_data_client_handle dc,
01499     const char* name,
01500     const int16_t severity,
01501     const tek_sa_field_handle source,
01502     tek_sa_alarm_handle* new_alarm_handle);
01503
01522 TEK_SA_RESULT(*register_enum_type)(tek_sa_data_client_handle dc,
01523     struct tek_sa_enum_definition const* type_definition,
01524     tek_sa_type_handle* new_type_handle);
01525
01536 TEK_SA_RESULT(*register_struct_type)(tek_sa_data_client_handle dc,
01537     struct tek_sa_struct_definition const* type_definition,
01538     tek_sa_type_handle* new_type_handle);
01539
01556 TEK_SA_RESULT(*post_event)(tek_sa_data_client_handle dc, struct tek_sa_dc_event const* event);
01557
01569 TEK_SA_RESULT(*set_alarm)(tek_sa_data_client_handle dc, const tek_sa_alarm_handle alarm);
01570
01579 TEK_SA_RESULT(*reset_alarm)(tek_sa_data_client_handle dc, const tek_sa_alarm_handle alarm);
01580
01605 TEK_SA_RESULT (*log)(tek_sa_data_client_handle source, enum tek_sa_log_level_t lvl,
01606     const char* format, va_list args);
01607
01621 tek_sa_event_handle (*get_global_event)(const char* name);
01622

```

```

01630     TEK_SA_RESULT (*update_capabilities) (
01631         tek_sa_data_client_handle dc,
01632         struct tek_sa_data_client_capabilities const* capabilities);
01633
01653     TEK_SA_RESULT (*read_progress) (tek_sa_data_client_handle dc, uint64_t request_id,
01654         uint64_t progress);
01655
01677     TEK_SA_RESULT (*read_result) (tek_sa_data_client_handle dc, uint64_t request_id,
01678         TEK_SA_RESULT result,
01679         const struct tek_sa_read_result results[],
01680         size_t number_of_results);
01681
01689     TEK_SA_RESULT (*notify_change) (tek_sa_data_client_handle dc,
01690         const struct tek_sa_read_result changes[],
01691         size_t number_of_changes);
01692
01703     TEK_SA_RESULT (*write_result) (tek_sa_data_client_handle dc, uint64_t request_id,
01704         TEK_SA_RESULT result,
01705         const struct tek_sa_write_result results[],
01706         size_t number_of_results);
01707
01719     TEK_SA_RESULT (*call_method_result) (tek_sa_data_client_handle dc, uint64_t request_id,
01720         TEK_SA_RESULT result,
01721         const tek_sa_field_value results[],
01722         size_t number_of_results);
01723
01740     TEK_SA_RESULT (*block_read_data) (tek_sa_data_client_handle dc, uint64_t request_id, TEK_SA_RESULT
01741         result,
01742         unsigned char buffer[], size_t buffer_length);
01743
01757     TEK_SA_RESULT (*block_write_data) (tek_sa_data_client_handle dc, uint64_t request_id, unsigned char
01758         buffer[],
01759         size_t buffer_length, size_t* bytes_written);
01760
01768     TEK_SA_RESULT (*block_write_result) (tek_sa_data_client_handle dc, uint64_t request_id,
01769         TEK_SA_RESULT result);
01770
01772 };
01773 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, register_field, 0, 0);
01774 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, register_method, 4, 8);
01775 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, register_event, 8, 16);
01776 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, register_alarm, 12, 24);
01777 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, register_enum_type, 16, 32);
01778 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, register_struct_type, 20, 40);
01779 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, post_event, 24, 48);
01780 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, set_alarm, 28, 56);
01781 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, reset_alarm, 32, 64);
01782 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, log, 36, 72);
01783 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, get_global_event, 40, 80);
01784 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, update_capabilities, 44, 88);
01785 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, read_progress, 48, 96);
01786 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, read_result, 52, 104);
01787 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, notify_change, 56, 112);
01788 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, write_result, 60, 120);
01789 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, call_method_result, 64, 128);
01790 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, block_read_data, 68, 136);
01791 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, block_write_data, 72, 144);
01792 TEK_SA_VERIFY_STRUCT_OFFSET(tek_sa_transformation_engine, block_write_result, 76, 152);
01793
01809 typedef TEK_SA_RESULT (*tek_sa_load_plugin_fn) (
01810     struct tek_sa_transformation_engine* api,
01811     const struct tek_sa_data_client_configuration* plugin_configuration,
01812     struct tek_sa_data_client_plugin* plugin,
01813     struct tek_sa_configuration* tek_configuration);
01814
01815 #ifdef TEK_SA_DATA_CLIENT_IMPL
01816
01817 #ifdef _WIN32
01818 #define TEK_SA_API_EXPORT __declspec(dllexport) __stdcall
01819 #else
01820 #define TEK_SA_API_EXPORT __attribute__((__visibility__("default")))
01821 #endif
01822
01826 TEK_SA_RESULT TEK_SA_API_EXPORT
01827     load_plugin(struct tek_sa_transformation_engine* api,
01828         const struct tek_sa_data_client_configuration* plugin_configuration,
01829         struct tek_sa_data_client_plugin* plugin,
01830         struct tek_sa_configuration* tek_configuration);
01831
01832 #endif
01833
01834 #ifdef __cplusplus
01835 }
01836 #endif
01837
01838 #undef TEK_SA_STRUCT_ALIGN_SELECT
01839 #undef TEK_SA_VERIFY_STRUCT_OFFSET

```

```
01840
01841 #endif /* TEK_SOUTH_API_H */
```


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