Structured Data Standards

XINA standard data structures terms and organizing principles.

Introduction

Although XINA is very flexible and can be configured to meet almost any data organization requirements, we have defined standard organization principles for common use cases with pre-built front end tooling. By adhering to these standards projects can quickly leverage built-in XINA front end tools and data processing pipelines, as well as first class API actions for interacting with data in complex ways. We call this collection of standards **structured data standards**, or **structs**.

These are not hard limitations of the overall XINA system, but serve as our recommended entry point into using XINA based on past experience, performance benchmarks, and cost/benefit analysis.

Data Organization

Structs XINA groups employ certain organizational requirements to ensure they are interpretted correctly by structs API calls and front end tools.

Data Models

The primary organizational concept of the struct system is the **data model**. Abstractly, a data model (or simply **model**) is defined as having a set of **synchronously relevant data**. For example, a project might have a flight model, ETU model, etc. Models store data in independent databases, and multiple models may import data in parallel.

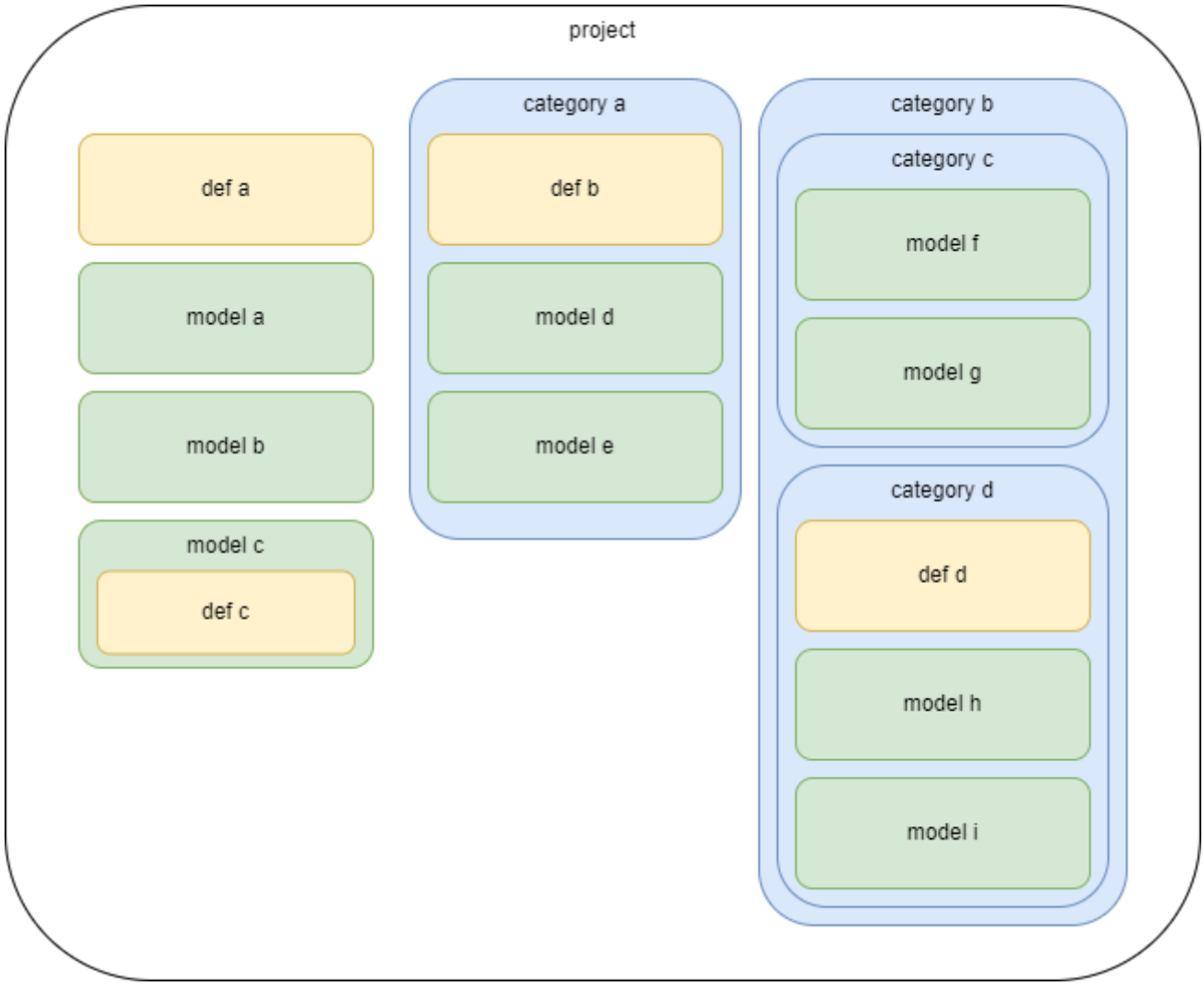
Broadly we use **time** as the primary method to organize and synchronize data within a model. In XINA this is represented as an 8-byte unsigned integer Unix time with microsecond precision. We use Unix time because it is:

- Widely and consistently supported
- Time zone independent
- Efficiently convertible to other formats and time systems

Other time formats may be available for data export depending on project requirements.

Projects / Categories

Projects and categories provide organization for multiple models. A project is a top-level group containing multiple models and/or categories, with each category containing multiple models or further categories. Project and category groups may also include additional groups and databases of data or resources which are not model specific, such as notebooks or definitions databases. In most cases with standard structures, models will default to databases or groups within the model, but search for them up the tree if not found. A complete project group might look like:



Note the definitions groups, which provide context for the data in models. A model is associated with the definitions defined by its closest ancestor. In this case, `"definitions a"` apply to models `a`, `b`, `f`, and `g`, `"definitions b"` to models `d` and `e`, `"definitions c"` to model `c`, and `"definitions d"` to models `h` and `i`.

In practice it is strongly recommended to use a single definitions group as broadly as possible to facilitate comparing data. Tools are designed to efficiently compare data (even across models) with the same set of definitions.

Model Organization

Data within a model falls into four primary classifications:

- **Telemetry**
  - source data file(s) from data collection point
  - typically stored in a raw (sometimes binary) format
  - storage cost is cheap
  - accessing data means downloading files or most likely requires custom XINA tools
  - may be divided into multiple **pipes** (see below)
- **Viewable Data**
  - extracted from telemetry into XINA database(s)
  - telemetry is the single source of truth for this data, not intended to be user editable
    - (except under controlled circumstances with struct API calls)
  - data is either **mnemonic**, **instant**, or **interval** (see below)
  - can be accessed and analyzed with built-in XINA tools

    - storage is expensive
    - optimizations may be needing depending on project requirements, data volumes
- **User Metadata**
    - additional data added by users, often directly through the XINA interface
    - XINA likely the primary repoository for this data
    - for example, a notebook
- **Definitions / References**
    - may be user entered or defined outside XINA
    - may exist at model level or above (category/project level)
    - more formal and restricted than user metadata

Pipes

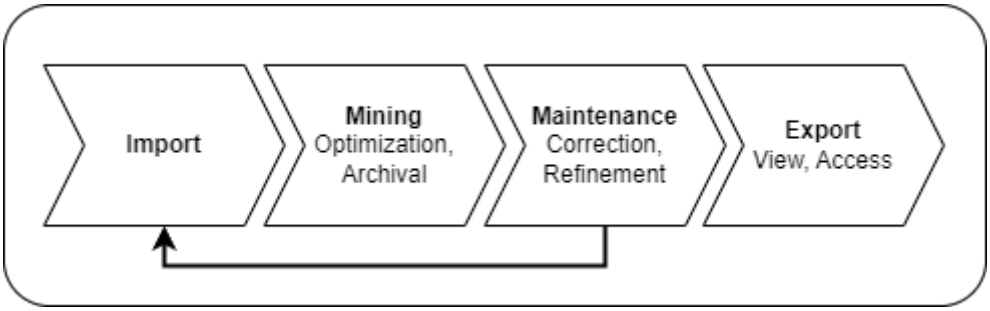
Abstractly, a **data pipe** (or simply **pipe**) is a single point of data import to a model. In many cases, a model will only have a single pipe; for example, if all data is provided directly from a single instrument, or multiple components are merged into a single data stream through FEDS before import into XINA.

However, in environments with multiple import points running in parallel, databases must be designed with multiple origins.

In this example each source file would need to specify either `origin_a` or `origin_b`. Additionally, each origin has distinct databases for instant, interval, and mnemonic data. This would be required if each data source provided all three data types. As requirements for instants and intervals are less stringent than mnemonics, in some circumstances instants and intervals could be considered a single source and populated independently:

Data Lifecycle

The XINA structs mnemonic data lifecycle involves four primary phases:



Source Files

Each pipe maintains a set of **source files**, containing all data imported into XINA for that pipe.

The primary type of source files are **archive source files**. Archive files are considered the **definitive record of source data for a range of time for a single pipe**. These are stored in the XINA xbin binary file format. These are imported directly with the STRUCT ARCHIVE IMPORT action. Archive files are **mined** through the XINA Structs Mine task into XINA databases in order to be viewed in the XINA client, and are used to generate export packages.

Alternatively, an pipe may use **buffer source files**. Buffer files may be imported in a variety of data formats and are not subject to the same strict requirements as archive files. These may are imported directly with the STRUCT BUFFER IMPORT action. Mnemonic data from buffer files is loaded into a temporary buffer database for immediate viewing in the XINA client. Buffer files are **archived** (merged and converted into archive files) through the XINA Structs Archive task, which can be run manually or configured to run in regular intervals. *This is the recommended approach for importing mnemonic data when getting started with XINA Structs.*

Data Flow

In general, there are three supported approaches for pipe data flow: **buffer** import, **variable time archive** import, and **fixed time archive** import. While a single pipe can only support one workflow, a model may combine multiple workflows using multiple pipe.

Buffer Import

The buffer import workflow is the most flexible mnemonic import method. Buffer files do not need to adhere to strict requirements (aside from conforming to standard accepted file formats). Buffer files for a given pipe may have duplicated data, overlapping data, and can introduce new mnemonic definitions on demand.

Buffer files are imported with the STRUCT BUFFER IMPORT action. This invokes three effects:

- the raw buffer file is parsed, validated, and stored in the model pipe **mnemonic buffer file database**
- new **mnemonic definitions** are created for any unrecognized mnemonic labels
- data is added to the **mnemonic buffer database** for the associated pipe

No additional data processing occurs as part of this step. XINA models utilizing buffer source files must implement routine execution of the `STRUCT_BUFFER_ARCHIVE` asynchronous task (typically every hour) to merge the files into archive files in a fixed-time archive format, which can then be processed by `STRUCT_ARCHIVE_MINE` tasks to fully process data into model standard databases.

Pros

- minimal client side configuration required to get started
- allows smaller, faster file uploads to view data close to real-time
- flexible and responsive to changing environments, mnemonics, requirements

Cons

- performance is worse than client side aggregation
- not recommended above 1k total data points per second

Struct Archive Task

The XINA Struct Archive task merges and compresses buffer files into archive files. This step is required to resolve any data discrepancies and ensure data is preserved in accordance with the requirements of archive files. The task performs the following steps:

- load all unprocessed files from the buffer file database
- for each time ranges affected by unprocessed files
  - process each file into processed format
  - load any existing processed files in those time ranges
  - merge data from all processed files for time range into single archive file
  - upload newly processed buffer files
  - delete unprocessed buffer files
  - upload merged archive file
  - run mining task on merged archive file
  - delete any mnemonic data already present for time range
  - import mnemonic data generated by mining task

Direct Archive Import

Archive files are imported directly with the STRUCT ARCHIVE IMPORT action.

Pros

- much higher performance ceiling than server side aggregation
- stringent validation ensures data conforms to standard

Cons

- more complex initial setup
- mnemonic definitions must be pre-defined and cannot be added on-the-fly
- mnemonic definitions need coordination between client and server
- changes are more complex and likely involve human interaction

Fixed-Time Archive Import

With fixed-time archive import each archive has a fixed time range. This is a recommended solution for projects which generate a persistent data stream (for example, data sources piped through a FEDS server).

Variable-Time Archive Import

With variable-time archive import each archive specifies a custom time range. This is a recommended solution for projects which generate their own archival equivalent (for example, outputting a discrete data set after running a script). Because the time ranges are determined by the source data, it is recommended to generate interval events matching each file as a time range reference.

Source File Formats

Currently there are two natively supported general purpose formats, one using the codes `csv` / `tsv` (full documentation here), and a binary format using the code `xbin` (full documentation here) Additional formats will be added in the future, and custom project-specific formats may be added as needed.

Assumptions and Limitations

Each archive source file is considered the **single source of truth for all mnemonics, instants, and intervals for it's associated pipe for its time range**. This has the following implications:

Archive files with the same pipe cannot contain overlapping time ranges. If an import operation is performed with a file violating this constraint the operation will fail and return an error.

Within a single model, each mnemonic may only come from a single pipe. Because mnemonics are not necessarily strictly associated with models, and the source may vary between models, this cannot be verified on import and must be verified on the client prior to importing data.

Mnemonics

A **mnemonic** defines a single field of **numeric** data in a XINA model. A **datapoint** is a single record of a mnemonic, consisting of:

- time (Unix microseconds)
- mnemonic identifier
- value (numeric)

In other words, **the value of a single mnemonic at a moment in time**.

A model has one or more mnemonic databases, containing all of the datapoints associated with the model.

Mnemonic Definitions

All mnemonics are defined in a **mnemonic definitions** database. It is **strongly recommended** to use a single definitions database for an entire project to faciliate comparison of data between models.

A core challenge of working with mnemonics is synchronizing mnemonic definitions from XINA to the point of data collection. Especially in early test environments, fields may be frequently added or removed on the the fly and labels may change, but must be consistently associated with a single mnemonic definition. Broadly there are two approaches to manage this challenge.

The first is user maintained mnemonic definitions. This is recommended for environments without frequent changes, and ideally one data source. The end user is responsible for ensuring that imported data has matching `mn_id` values to mnemonics present in the definitions database. This will typically result in faster imports and support complex or custom data pipeline solutions.

The second solution is allowing XINA to manage mnemonic definitions. With this approach, data can be imported with plain text labels and automatically associated with mnemonic definitions if available, or new definitions can be created on the fly.

Both approaches can be accomplished with the `model_mn_import` API action, documented here. The details of the required approach will depend on project requirements.

Fields

Mnemonic ID

Unique numeric ID, assigned by XINA.

Name

Mnemonic name. Conforms to structs naming conventions. Must be unique in combination with subname and unit.

Subname

Essentially a name suffix.

Description

Optional plain text mnemonic description.

Unit

Optional (but strongly recommended) measurement unit (for example, `V`, `mA`, etc).

Standard Fields

field	type	description
`state`	`model_mn_state`	current state of mnemonic (`active`, `inactive`, `archived`, `deprecated`)
`origins`	`jsonobject`	map of model(s) to associated origin(s)
`full`	`asciivstring(32)`	the primary database for the mnemonic, default `f8` (may be `null`)
`bin`	`set(asciivstring(32))`	the opt-in bin database(s) to include the mnemonic in
`format`	`asciivstring(32)`	printf-style format to render values
`enum`	`jsonobject`	mapping of permitted text values to numeric values
`labels`	`list(jsonobject)`	mapping of numeric values or ranges to labels
`aliases`	`set(asciivstring(128))`	set of additional names associated with the mnemonic
`meta`	`jsonobject`	additional metadata as needed
`query`	`asciivstring(32)`	query name for meta-mnemonics (may be `null`)
`conf`	`jsonobject`	configuration for meta-mnemonics (may be `null`)

Although the mnemonic name is intended to be unique, insertion of a mnemonic with the same name but different unit will create a new mnemonic definition. This is intended to avoid interruption of data flow, but should be corrected with the Mnemonic Management tool when possible. The `model` and `origin` are populated automatically for auto-generated mnemonic definitions.

The mnemonic `state` affects how the mnemonic will be displayed and populated. An `inactive` mnemonic indicates data is no longer relevant or actively populated and will be hidden by default. A `deprecated` mnemonic extends this concept but will throw errors if additional data points for the mnemonic are imported.

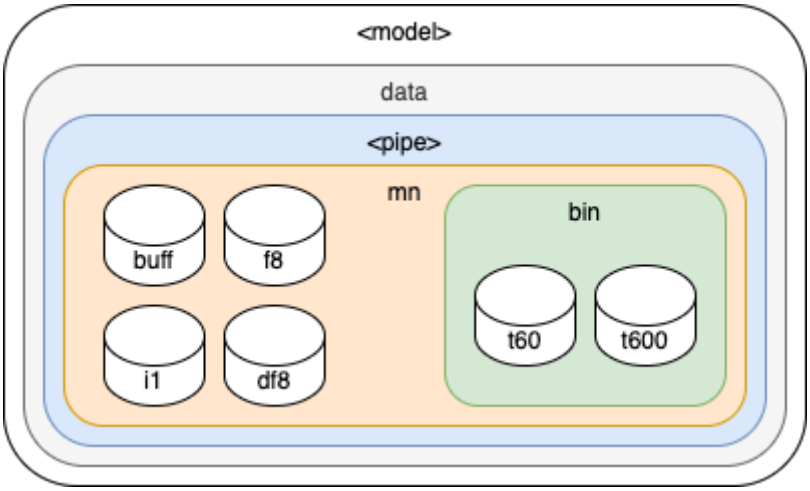
If `enum` is provided a mnemonic will apply labels to enumerated numeric values, as provided in `values`. For example, a 0|1 on|off state could be represented by `{"0":"OFF", "1":"ON"}`. Values in this map may also be used to parse imported data.

A mnemonic may specify one or more `aliases` to indicate additional names that should be included in the single mnemonic definition. If present, the aliases are referenced at a **higher priority** than the mnemonic name during import lookup. For example, a given mnemonic `a` is erroneously labeled `b` in some imported data, which creates a new separate mnemonic definition for `b`. To correct this, `b` could be added as an alias for `a`, and the `b` mnemonic could be deprecated. All `a` and `b` data from the source telemetry would then correctly be merged into the `a` mnemonic.

`name`, `unit`, `state`, `enum`, `models`, and `aliases` may be used during the data import process to validate and interpret data. Full details of how each field is used is documented with the associated API action.

Mnemonic Databases

Within a model, each data source must have a set of one or more mnemonic databases. Each set should be contained by a group, which can be configured to define any relationships between the databases. This will typically include a **full** database, containing all or **delta** optimized data (see below for additional information), and one or more types of **bin** databases, depending on requirements.



While each data source must have its own mnemonic database(s), it may be beneficial for a single data source to further subdivide mnemonics into different types of databases for optimization purposes. For example, a model with a large number of mnemonics that only require single byte precision would see significant performance gains from separate databases using the `int(1)` type. In practice this could look like:

Full Database

In most cases, there will be a single primary database containing **full mnemonic** data (all points from original telemetry), **delta mnemonic** data (an optimization option, see below), or a mix of both. Data is stored with a single data point per row.

A value of `null` may be used for `v` to indicate a gap in data, otherwise data will appear visually connected by default in XINA charts. `null` may also be appropriate to represent `NaN` or `Inf` values, as these cannot be stored in the database, but the preference to include these as `null` or omit them altogether may depend on an individual mnemonic.

For large data sets with infrequent value changes, it may be beneficial to employ a **delta mnemonic** optimization. This requires the `n` field listed above. In this case, a point is only included in the database at the moment the value for a given mnemonic changes, and the number of points is stored in `n`. For example, given the set of points:

t	v
0	0
1	0
2	0
3	1
4	1

t	v
5	1
6	1
7	2
8	2
9	2

Delta optimization would condense the data to:

t	v	n
0	0	2
2	0	1
3	1	3
6	1	1
7	2	2
9	2	1

Note the final data point of a data set is always included.

Bin Database(s)

The most common data optimization employed with mnemonics is **binning**, combining multiple data points over a fixed time range into a single data point with a min, max, avg, and standard deviation. A model may define one or more bin databases depending on performance requirements, but four types are supported by default. The time range of bins is interpretted as `[start, end)`.

Time Binning

Bins are applied on a **fixed time interval** for all points in the database (for example, 1 minute or 1 hour).

Standard Fields

field	type	description	required
`t`	`instant` (matching model standard)	start time of the bin	yes
`t_min`	`instant` (matching model standard)	time of first data point in bin	yes
`t_max`	`instant` (matching model standard)	time of last data point in bin	yes
`mn_id`	`int(4)`	unique mnemonic ID	yes
`n`	`int(4)`	number of data points in bin	yes
`avg`	`float(8)`	average of points in bin	yes
`min`	`float(8)`	min of points in bin	yes
`max`	`float(8)`	max of points in bin	yes

field	type	description	required
med	float(8)	median of points in bin	no
var	float(8)	variance of points in bin	no
std	float(8)	standard deviation of points in bin	no

Interval Binning

Bins are based on explicitly defined **intervals**.

Standard Fields

field	type	description	required
t_start	instant(us)	start time of the bin	yes
t_end	instant(us)	end time of the bin	yes
dur	duration(us)	duration	yes
t_min	instant(us)	time of first data point in bin	yes
t_max	instant(us)	time of last data point in bin	yes
u_id	UUID	UUID of associated interval	yes
p_id	int(8)	primary ID of associated interval	yes
s_id	int(4)	secondary ID of associated interval	yes
mn_id	int(4)	unique mnemonic ID	yes
n	int(4)	number of data points in bin	yes
avg	float(8)	average of points in bin	yes
min	float(8)	min of points in bin	yes
max	float(8)	max of points in bin	yes
med	float(8)	median of points in bin	no
var	float(8)	variance of points in bin	no
std	float(8)	standard deviation of points in bin	no

Events

Events are the primary means of organizing structs data. They have two forms: **instants**, referring to a **single moment in time**, and **intervals**, referring to a **range of time**. The goal of events is to make it easy to find, compare, and trend data.

Fields

Unlike most structs databases, event databases may include as many custom fields as required, so long as they do not conflict with the required standard fields:

UEID

Universally unique event identifier (UUID). Intended to permanently, globally specify each event. Should be generated at the creation of the event to ensure consistency even if data is reprocessed.

Event ID

Optional numeric reference to an event definition (also see below). If not provided, defaults to `0`.

Type

Indicates how the event should be viewed and interpreted. The options are defined by XINA.

Level

Indicates how the event should be viewed and interpreted. The options are defined by XINA.

Label

Required plain text description of the event. Limited to to 128 bytes for indexing.

Content

Optional plain text, HTML, or JSON of unlimited length.

Meta

Optional JSON object of arbitrary additional content.

Types

XINA defines a fixed set of standard event types, each with an associated numeric code. The type is stored as the code in the database for performance reasons; for practical purposes most actions can use the type name directly, unless interacting directly with the API.

Standard Types

Code	Name	Ins	Int	Description
0	message	?	?	Basic event, ID optional
1	marker	?	?	Organized event, ID required
2	alert	?	?	Organized event, ID required, level (severity) required
2000	test		?	Discrete test period, may not overlap other tests, ID optional
2001	activity		?	Discrete activity period, may not overlap other activities, ID optional
2002	phase		?	Discrete phase period, may not overlap other phases, ID optional
2010	filter		?	Filter state
3000	data	?	?	General purpose data set
3001	spectrum	?	?	General purpose spectrum data

Additional types will be added in the future as needed, with codes based on this chart:

Standard Type Code Ranges

code	ins	int	description
0-999	?	?	General types for instants and intervals
1000-1999	?		General types for instants only
2000-2999		?	General types for intervals only
3000-3999	?	?	Data set types for instants and intervals
4000-4999	?		Data set types for instants only
5000-5999		?	Data set types for intervals only

Definitions

As with mnemonics, events may be identified with event definitions. However, unlike mnemonics, not every event requires a definition. The event ID field associates an event with an event definition. Each event ID is associated with a unique name, describing the definition. These work similarly to mnemonic names for purposes for definition creation. If an event is inserted with an unrecognized name, a new definition will be created for that name and assigned a new event ID.

Context

An event database may either be a child of a model or pipe group. A model event database is essentially like any other XINA database, but with support for the STRUCT EVENT API actions.

Pipe event databases are more restrictive. The events must be embedded in the data set of the pipe, and cannot be inserted manually. Each event is associated with the archive in which it starts. Events may cross archive boundaries by initially being inserted as `open` events (having a start time but no end time) and later using the `$event.close` operation to assign an end time. Additionally, pipe event databases have an associated event change database to track manually applied updates outside of the source data set. This allows changes to be preserved if data is remined from the archive files. The intention is that these accurately reflect the archived data, so fields must opt-in to being editable by this operation.

Data Formats

The `data` event type indicates a basic data set. This is typically used with the single file per event database structure, in which case the file will contain the data set. For event databases without files, the data is expected to be stored in the `content` field. This is only recommended for small datasets (less than 1MB).

Files must be either ASCII or UTF-8 encoded. New lines will be interpretted from either `\n` or `\r\n`. The `conf` object may define other customization of the format:

Conf Definition

Key	Value	Default	Description
`delimiter`	`string`	auto detect (`','`, `'\t'`, `';'`)	value delimiter
`quoteChar`	`character`	`"` (double quote character)	value quote character
`ignoreLines`	`number`	`0`	number of lines to skip before the header
`invalid`	`null`, `'NaN'`, `number`	`null`	preferred interpretation of invalid literal
`nan`	`null`, `'NaN'`, `number`	`null`	preferred interpretation of `'Nan'` literal
`pInfinity`	`null`, `'Inf'`, `number`	`null`	preferred interpretation of positive `'Infinity'` literal
`nInfinity`	`null`, `'Inf'`, `number`	`null`	preferred interpretation of negative `'Infinity'` literal
`utc`	`boolean`	`false`	if `true`, interpret all unzoned timestamps as UTC

Starting after the number provided for `ignoreLines`, the content must include a header for each column, with a name and optional unit in parentheses. Special standard unit names may be used to indicate time types, which will apply different processing to the column:

Unit	Description
`ts`	text timestamp, interpretted in local browser timezone (absent explicit zone)
`ts_utc`	text timestamp, interpretted as UTC timezone (absent explicit zone)
`unix_s`	Unix time in seconds

Unit	Description
`unix_ms`	Unix time in milliseconds
`unix_us`	Unix time in microseconds

Structs Data Format

Structs data files can contain mnemonic and/or event data. They have two basic forms, **archive** files, which must use the XBin format, and **buffer** files, which may either use the structs DSV format or the XBin format. In either format, they essentially provide a set of time-key-value mappings. By default keys are interpretted as mnemonics, unless they start with the dollar sign (`$`) character, in which case they are interpretted according to the rules of this document. Currently this is only used to embed event data, but additional features may be added in the future.

Note that buffer files are only intended to be imported with the STRUCT BUFFER IMPORT API action.

Mnemonics

Mnemonic data may either be denoted by the numeric mnemonic ID, or text mnemonic name. The value will be interpretted as a mnemonic ID if it is a numeric XBin type, or if it is a string containing only digit characters. If the ID is used, it must already be associated with an existing mnemonic definition, or an error will be thrown. Otherwise the text will be parsed as follows:

```
mnemonic   = name [ ';' subname ] [ ( '::' unit-enums ) | ( '(' unit-enums ')' ) ] [ '#' description ]
unit-enums = unit [ ';' enums ]
enums      = enum | ( enums [ '|' enum ] )
enum       = [ integer '=' ] label
```

The parsed mnemonic has five elements: the **name**, **subname**, **unit**, **enum map**, and **description**. Only the name is required. The combination of name, subname, and unit are used to lookup an existing mnemonic. The comparison is case insensitive and any whitespace is treated as a single underscore. If a matching mnemonic is not found, a new mnemonic is created automatically. Note that the overall name cannot contain the colon (`:`), semicolon (`;`), dollar sign (`$`), or number sign (`#`) characters.

The enum map specifies a one-to-one map of integer values to text labels. This is optional and unlike the other parameters, not interpretted as a key component of the mnemonic. They will be included in the generated mnemonic definition if it doesn't exist.

Events

Event operations may also be embedded in structs data files. These are indicated by keys which start with `$event`. The supported operations are inserting instant events, opening interval events, and closing interval events. Events may specify a textual `"name"` instead of `"e_id"`, which can be used to lookup a corresponding event definition ID, or create a new event definition if one does not exist with the provided name. From a user's perspective, a `name` can be easier to remember and more descriptive than a numeric `e_id`. The event's `a_id_start` (Start Archive ID) and `a_id_end` (End Archive ID) will be automatically populated with the Archive ID of the file being processed.

For the purposes of the following examples, assume a model "m" contains a pipe "p" with 3 event databases, "e", "ef" (single file per event), and "efs" (multi-file per event).

See also the Events and Event Definitions references for the supported fields.

Insert Event Operation

```
$event.insert.<database name>
```

Creates a single event which may be an instant or a completed interval. The database name must correspond to an event database in the associated pipe. The value must be a JSON object in the standard record format, with fields appropriate to the specified Events database. The event must omit both the `"t_start"` and `"t_end"` values which will be populated by the time value from the corresponding row in the buffer file. The `a_id_start` and `a_id_end` will be populated from the file's `a_id`.

Open Interval Event Operation

```
$event.open.<database name>
```

Creates a single open event (interval with a start time and no end time). Uses the key `$event.open.<database name>`. The value must be a single JSON object, defining the content of the event record. The event must omit both the `"t_start"` and `"t_end"` values (`"t_start"` is populated by the row time, and `"t_end"` is `null` for an open interval). The `a_id_start` will be populated from the file's `a_id`.

Close Interval Event Operation

```
$event.close.<database name>
```

Closes an existing open event. The value must be a single JSON object, which may be used to update the values of any fields of the event. The object must omit both the `"t_start"` and `"t_end"` values (`"t_start"` cannot be edited, and `"t_end"` is populated by the row time). The `a_id_end` will be populated from the file's `a_id`.

Structs DSV Format

The XINA Structs DSV (delimiter separated values) format provides a standard delimited text data file format. This is recommended for data files attached to events, and forms the basis for the structs buffer file format.

Files have certain standard requirements:

- Must be UTF-8 encoded
- New lines will be interpretted from either `\n` or `\r\n`
- Blank lines will be ignored
- Lines starting with the `#` character are treated as comments and ignored

The `conf` object may define other customization of the format:

Key	Value	Default	Description
delimiter	string	`','` (comma character)	value delimiter
quote_char	character	`"` (double quote character)	value quote character
ignore_lines	number	`0`	lines to ignore at the start of the file
zone	string	UTC	time zone to use if not provided
values	JSON object		preferred interpretation of string literals (see below)

It is strongly recommended to include a unique appropriately generated 128-bit UUID in the standard 36 character format as a comment in the first processed line of each file. (If `ignore_lines > 0`, this would be the first line after that number of lines.)

There are two format modes for DSV files: the **row** format, in which each line contains a time, label, and value, and the **column** format, in which each row contains a time and one or more values. The first processed uncommented line will be intepretted as the column header, which is used to determine the file format. The file will be treated as row mode if it contains exactly three columns, with each having one of the reserved column names in the table below.

Name	Description	Alternate Names
t	Unix time or ISO8601 zoned timestamp	ts, time, timestamp, datetime, unix_time, unix, utc
k	key	key, m, m_id, mn, mn_id, mnemonic, mnemonic_id, n, name
v	value (numeric, empty, or `null`)	val, value

The header is used to determine the order of the columns.

For example (whitespace added for clarity, not required):

```
# 123e4567-e89b-12d3-a456-426614174000
t , k    , v
0 , v_mon , 1
0 , i_mon , 5
1 , t_mon , 100
2 , v_mon , 1.1
2 , i_mon , 4
3 , t_mon , null
4 , v_mon , 1.2
4 , i_mon , 3
5 , t_mon , 101
```

Otherwise, the file will be interpretted as the column format, where the first must be the time column, followed by a column for each mnemonic. The column headers must specify the mnemonic name or ID for each column.

For example, the following is equivalent to the above example (whitespace added for clarity, not required):

```
# 123e4567-e89b-12d3-a456-426614174000
t , v_mon , i_mon , t_mon
0 , 1     , 5     ,
1 ,       ,       , 100
2 , 1.1   , 4     ,
3 ,       ,       , null
4 , 1.2   , 3     ,
5 ,       ,       , 101
```

Time Parsing

The mode of time processing is determined by the value for `t` in `conf`. The `auto` mode attempts to interpret the most likely formatting for the timestamp. If the value is an integer or floating point format, it will be interpretted as a Unix timestamp, with precision based on these rules:

- t > `1e16`: error, value above typical range
- t > `1e14`: microseconds
- t > `1e11`: milliseconds
- t > `1e8`: seconds
- t <= `1e8`: error, value below typical range

Otherwise it will be interpretted as a zoned ISO8601 timestamp. If `t` is set explicitly in the configuration the time will always be interpretted in that context. The ISO timestamp may use the standard format:

`2023-05-31T17:55:07.000`

Or condensed format:

`20230531T175507.000`

If the `zone` property provided in the configuration, the timestamps do not require a zone. Otherwise they must include an explicit zone.

Non-Numeric Values

Values which are non-numeric may be ignored, treated as `null`, or mapped to explicit values using the `values` property of the `conf` object. Ignored values are treated by XINA as though they do not exist in the file. `null` values are stored as an actual data point in the XINA database, but with the value `null` instead of a numeric value. (This is primarily useful to create a visual gap in plots.)

The following values are **ignored** by default (note, case-insensitive and whitespace agnostic):

- `""` (empty string)
- `"nv"` (no value, ITOS)
- `"na"`
- `"n/a"`

The following values are interpretted as `null` by default (note, case-insensitive and whitespace agnostic):

- `"null"`
- `"nil"`
- `"none"`
- `"nan"`
- `"inf"`
- `"+inf"`
- `"-inf"`
- `"infinity"`
- `"+infinity"`
- `"-infinity"`

Custom value interpretations may be specified in the values object as either `"ignore"`, `null`, or a numeric value. For example:

```
{
 "?": "ignore",
 "notta": null,
 "onetwothree": 123
}
```

Any text value which does not include a custom or default mapping will cause an error. The defaults may be extended in the future.

Structs Ids List Format

> WORK IN PROGRESS

The Struct Ids List format is a comma delimited string format for storing references to mnemonics. It is used in various Definitions such as the Profile Definition to store which mnemonics should be included in the Export Package.

The string format should be parsed as:

- Comma delimited, whitespace ignored
- For each item in list:
  - unroll each instance of `#[]`
  - instance can only contain numeric values or numeric ranges
  - characters before `#` and after `]` should be prefixed and appended to each unrolled item, respectively
- For each unrolled item:
  - if starts with @, treat as `ext_id`
  - if starts with a digit
    - if contains `-`, treat as a numeric range
    - else, treat as single `mn_id`
  - otherwise treat as `name[;subname]` (aka mn key)

A numeric range is shorthand syntax for a range of numbers. For example `3-6` should be expanded to `3,4,5,6`.

Example:

```
@#[1,2,3]sci,name;subname,@100sci,@#[1,5-6,13,15-17]raw,15,20-22,#[40,50-52],30,name2
```

Will be parsed into:

`mn_ids`: [15, 20, 21, 22, 40, 50, 51, 52, 30]

`ext_ids`: ["1sci", "2sci", "3sci", "100sci", "1raw", "5raw", "6raw", "13raw", "15raw", "16raw", "17raw"]

`mn keys`: ["name;subname", "name2"]

XBin Format

The XBin (XINA Binary) format provides a XINA standard binary format for time based data files. It uses the file extension `xbin`.

The xbin format organizes **key-value** data by **time**. The data content is a series of **rows** in ascending time order, with each row having a single microsecond precision Unix time, unique within the file.

Segment Format

XBin data is often encoded in **segments**, which are defined by an initial 1, 2, or 4 byte unsigned integer length, then that number of bytes. These are referred to in this document as:

- **seg1** (up to 255 bytes)
- **seg2** (up to 65,535 bytes)
- **seg4** (up to 2,147,483,647 bytes)

If the length value of a segment is zero there is no following data and the value is considered **empty**.

Examples

The string `"foo"` has a 3 byte UTF-8 encoding: `0x66`, `0x6f`, `0x6f`.

As a seg1, this is encoded with a total of 4 bytes (the initial byte containing the length, 3):

`0x03` `0x66` `0x6f` `0x6f`

As a seg2, 5 bytes:

`0x00` `0x03` `0x66` `0x6f` `0x6f`

And as a seg4, 7 bytes:

`0x00` `0x00` `0x00` `0x03` `0x66` `0x6f` `0x6f`

Value Format

Each value starts with a 1 byte unsigned integer indicating the value type, followed by additional byte(s) containing the value itself, as applicable.

Value Type Definition

Code	Value	Length (bytes)	Description
`0`	`null`	0	literal `null` / empty string
`1`	ref dict index	1	index 0 to 255 (see below)

Code	Value	Length (bytes)	Description
2	ref dict index	2	index 256 to 65,535
3	ref dict index	4	index 65,536 to 2,147,483,647
4	true	0	boolean literal
5	false	0	boolean literal
6	int1	1	1 byte signed integer
7	int2	2	2 byte signed integer
8	int4	4	4 byte signed integer
9	int8	8	8 byte signed integer
10	float4	4	4 byte floating point
11	float8	8	8 byte floating point
12	string1	variable	seg1 UTF-8 encoded string
13	string2	variable	seg2 UTF-8 encoded string
14	string4	variable	seg4 UTF-8 encoded string
15	json1	variable	seg1 UTF-8 encoded JSON
16	json2	variable	seg2 UTF-8 encoded JSON
17	json4	variable	seg4 UTF-8 encoded JSON
18	jsonarray1	variable	seg1 UTF-8 encoded JSON array
19	jsonarray2	variable	seg2 UTF-8 encoded JSON array
20	jsonarray4	variable	seg4 UTF-8 encoded JSON array
21	jsonobject1	variable	seg1 UTF-8 encoded JSON object
22	jsonobject2	variable	seg2 UTF-8 encoded JSON object
23	jsonobject4	variable	seg4 UTF-8 encoded JSON object
24	bytes1	variable	seg1 raw byte array
25	bytes2	variable	seg2 raw byte array
26	bytes4	variable	seg4 raw byte array
27	xstring1	variable	seg1 xstring
28	xstring2	variable	seg2 xstring
29	xstring4	variable	seg4 xstring
30	xjsonarray1	variable	seg1 xjson array
31	xjsonarray2	variable	seg2 xjson array
32	xjsonarray4	variable	seg4 xjson array
33	xjsonobject1	variable	seg1 xjson object

Code	Value	Length (bytes)	Description
`34`	xjsonobject2	variable	seg2 xjson object
`35`	xjsonobject4	variable	seg4 xjson object
`36` - `255`	unusued, reserved		

XString Format

The **xstring** value type allows chaining mutliple encoded values to be interpretted as a string. The xstring segment length must be the total number of bytes of all encoded values in the string.

Note that although any data type may be included in an xstring, the exact string representation of certain values may vary depending on the decoding environment (specifically, the formatting of floating point values) and thus it is not recommended to include them in xstring values. JSON values will be converted to their minimal string representation. Byte arrays will be converted to a hex string. Null values will be treated as an empty string.

XJSON Array Format

The **xjsonarray** value type allows chaining mutliple encoded values to be interpretted as a JSON array. The xjsonarray segment length must be the total number of bytes of all encoded values in the array.

XJSON Object Format

The **xjsonobject** value type allows chaining mutliple encoded values to be interpretted as a JSON object. Each pair of values in the list is interpretted as a key-value pair. The xjsonobject segment length must be the total number of bytes of all encoded key-value pairs in the object. Note that key values must resolve to a string, xstring, number, boolean, or null (which will be interpretted as an empty string key).

Examples

Null Value:

Code	Content (0 bytes)
`0x00`	

300 (as 2 byte integer):

Code	Content (2 bytes)
`0x07`	`0x01` `0x2c`

0.24 (as 8 byte float):

Code	Content (8 bytes)
`0x0b`	`0x3f` `0xce` `0xb8` `0x51` `0xEB` `0x85` `0x1E` `0xb8`

"foo" (as string1):

Code	Content (4 bytes)
`0x0c`	`0x03` `0x66` `0x6f` `0x6f`

{"foo":"bar"} (as json1):

Code	Content (14 bytes)
`0x0f`	`0x0d` `0x7b` `0x22` `0x66` `0x6f` `0x6f` `0x22` `0x3a` `0x22` `0x62` `0x61` `0x72` `0x22` `0x7d`

"foo123" (as xstring1, split as string1 "foo" and int1 123):

Code	Content (7 bytes)
`0x1b`	[`0x06`](total length) [`0x03` `0x66` `0x6f` `0x6f`]("foo") [`0x04` `0x7b`](123)

Reference Dictionary

The xbin format provides user-managed compression through the reference dictionary. It can contain up to the 4 byte signed integer index space (2,147,483,647). The order of values affects the compression ratio; index 0-255 can be represented with a single byte, 256-65,535 with 2 bytes, and above requires 4 bytes.

Binary File Format

UUID

The file starts with a 16 byte binary encoded UUID. This is intended to uniquely identify the file, but the exact implementation and usage beyond this is not explicitly defined as part of the format definition. For XINA purposes two xbin files with the same UUID would be expected to be identical.

Header

A value which must either be `null` or a `jsonobject1`, `jsonobject2`, or `jsonobject4`. This is currently a placeholder with no defined parameters.

Reference Dict

A seg4 containing 0 to 2,147,483,647 encoded values, which may be referenced by zero based index with the reference dict index value types.

Rows

Each row contains:

- 8 byte signed integer containing Unix time with microsecond precision
- seg4 of row data, containing
  - header, single value which must either be `null` or a `jsonobject1`, `jsonobject2`, or `jsonobject4`
  - one or more key,value pairs

The row header is currently a placeholder with no defined parameters.

Example File

Given a data set with UUID 9462ef87-f232-4694-922c-12b93c95e27c:

t	voltage	current	label
0	5	10	"foo"
1			"bar"
2	5	null	

A corresponding xbin file containing the same data would be:

UUID (16 bytes)

`0x94` `0x62` `0xef` `0x87` `0xf2` `0x32` `0x46` `0x94` `0x92` `0x2c` `0x12` `0xb9` `0x3c` `0x95` `0xe2` `0x7c`

Header (1 byte)

`0x00` (null, 1 byte)

Reference Dict, three values, "voltage", "current", "label" (29 bytes)

`0x00` `0x00` `0x00` `0x19` (seg4 length, 25)

`0x0a` `0x07` `0x76` `0x6f` `0x6c` `0x74` `0x61` `0x67` `0x65` ("voltage", 9 bytes)

`0x0a` `0x07` `0x63` `0x75` `0x72` `0x72` `0x65` `0x6e` `0x74` ("current", 9 bytes)

`0x0a` `0x05` `0x6c` `0x61` `0x62` `0x65` `0x6c` ("label", 7 bytes)

Row t0 (22 bytes)

`0x00` `0x00` `0x00` `0x00` `0x00` `0x00` `0x00` `0x00` (time, 0, 8 bytes)

`0x00` `0x00` `0x00` `0x0e` (row length, 15, 4 bytes)

`0x00` (header, null, 1 byte)

`0x01` `0x00` (reference to index 0, "voltage", 2 bytes)

`0xff` (type code reference to index 0, 5, 1 byte)

`0x01` `0x01` (reference to index 1, "current", 2 bytes)

`0x04` `0x0a` (integer value 10, 2 bytes)

`0x01` `0x02` (reference to index 2, "label", 2 bytes)

`0x0a` `0x03` `0x66` `0x6f` `0x6f` (string "foo", 5 bytes)

Row t1 (20 bytes)

`0x00` `0x00` `0x00` `0x00` `0x00` `0x00` `0x00` `0x01` (time, 1, 8 bytes)

`0x00` `0x00` `0x00` `0x08` (row length, 8, 4 bytes)

`0x00` (header, null, 1 byte)

`0x01` `0x02` (reference to index 2, "label", 2 bytes)

`0x0a` `0x03` `0x62` `0x61` `0x72` (string "bar", 5 bytes)

Row t2 (19 bytes)

`0x00` `0x00` `0x00` `0x00` `0x00` `0x00` `0x00` `0x02` (time, 2, 8 bytes)

`0x00` `0x00` `0x00` `0x0e` (row length, 15, 4 bytes)

`0x00` (header, null, 1 byte)

`0x01` `0x00` (reference to index 0, "voltage", 2 bytes)

`0x00` (type code reference to index 0, 5, 1 byte)

`0x01` `0x01` (reference to index 1, "current", 2 bytes)

`0x00` (null, 1 byte)

Struct Extract Interface

> Warning: This page is a Work In Progress

For projects that use packet file archives, XINA Mining (struct_mining) and Export (struct_export) delegates the decoding and conversion of mnemonic data to a mission specific tool, which we will reference as `struct_extract`. This tool should implement the following interface for integration with XINA.

Environment

- The app should be runnable on Ubuntu 22.04.
- Any required environment setup will be performed on a per project basis.

Input

`struct_extract` should accept a single argument which is the path to a JSON file. The JSON file defines the parameters needed to extract the requested mnemonic data. Project specific keys can be added as needed. The following table defines the standard parameters:

> Note: If `raw`, `eng`, or `sci` are not provided, all mnemonics should be extracted as "science".

Key	Required	Description
dir	?	The path to the dir containing the archive file and any ancillary files needed for processing
dest	?	The path to the dir that all output (e.g. `xbin` file) should be placed
mission	?	TBC: The mission which may be needed to determine how the archive file is processed
model	?	TBC: The mission's model which may be needed to determine how the archive file is processed
raw		The mnemonic IDs of the mnemonics that should be extracted and output, unconverted
eng		The mnemonic IDs of the mnemonics that should be extracted and output with the engineering conversion applied
sci		The mnemonic IDs of the mnemonics that should be extracted and output with the science conversion applied

Key	Required	Description
time_mode		For projects that support it, defines which time source should be used when timestamping the mnemonic data. Either "pkt" or "grt" (ground receipt time). If not provided, it should default to packet time.

Example JSON configuration file:

```
{
}
```

Output

The output of the tool should be a xbin file. XINA's tools will then process the `xbin` file to produce the required mine or export products.

For mission specific data, `struct_extract` should output using one of the following options [TBD]:

- Self generate the data file and corresponding XINA JSON import file. XINA will take care of importing the data.
- Output the data into the xbin file. XINA will take care of the rest.

Return Codes

Return codes are used by the `struct_extract` app to return final execution status to the XINA processing.

Name	Code	Description
Success	0	Execution was successful
Error	1	Generic error code for unsuccessful execution. A more specific error code should be preferred over this one.
Finished with warnings	3	Execution finished but there were warnings. The log file should be examined for more info

Struct Definitions Reference

This page provides a reference for the purpose and structure of all structs standard groups and databases.

Structs groups and databases are marked with a JSON object using the key `xs_struct`. This contains three standard parameters:

- `"type"` - the name of the type of struct element as a string
- `"v"` - the current version this instance of the specified type as a string
- `"conf"` - optional JSON object, format depends on type

Versioning is tied to the version number of the XINA server. Typically server updates will automatically apply needed changes to all structs schema elements, incrementing their `"v"` property to the latest version. In the event an upgrade cannot be performed the version will not be changed.

Groups

Note that group versioning is used to manage databases required within groups.

Project

Top level struct group. All struct groups and databases must be decendants of a project to be recognized. Name and label are customizable.

Created with the STRUCT CREATE PROJECT action.

Struct Parameters

Parameter	Value
type	`"project"`

Group Parameters

Parameter	Value
name	*
label	*

Category

Mid-level struct group for organization. Must be a child of a project or category group. Name and label are customizable.

Created with the STRUCT CREATE CATEGORY action.

Struct Parameters

Parameter	Value
type	`"category"`

Group Parameters

Parameter	Value
name	*
label	*

Model

Group for which all data is locally co-relevant. Must be a child of either a project or category group. Name and label are customizable.

Created with the STRUCT CREATE MODEL action.

Struct Parameters

Parameter	Value
type	`"model"`

Group Parameters

Parameter	Value
name	*
label	*

Pipe

Group for all data from a single pipe. Must be the child of a model group. Name and label are customizable.

Created with the STRUCT CREATE PIPE action.

Struct Parameters

Parameter	Value	Default
type	`"pipe"`	

Conf Parameters

Parameter	Value	Default
discrete	boolean	`false`
buffer	boolean	`false`
variable	boolean	`false`
condense	boolean	`false`

Parameter	Value	Default
duration	archive length in minutes	`60`
partition	`{"from": <y0>, "to": <y1>}`	

Group Parameters

Parameter	Value
name	*
label	*

Notes

If `discrete` is `true`, mnemonic data is not considered persistent between archives, and open/close interval operations are not supported.

If `buffer` is `true`, the `mn_buffer` database will be generated, and the pipe will be included in automated archive tasks. Otherwise, the STRUCT BUFFER IMPORT action will not be supported.

If `variable` is `true`, mnemonic and event databases in the pipe will include the archive ID field (`a_id`). If `buffer` is `true`, `variable` must be `false` (since buffer-generated archives cannot be variable).

`duration` specifies the archive length in minutes, if `variable` is false. This cannot be changed. The default is 60 minutes (1 hour). A shorter window may be appropriate for very high data volumes. The maximum is 1440 (24 hours), and the value must be evenly divisible into 1440.

Changelog

11.0.0 (planned)

- renamed from `origin` to `pipe`

Definitions

Group containing definitions databases.

Struct Parameters

Parameter	Value
type	`"def"`

Group Parameters

Parameter	Value
name	`"def"`
label	`"Definitions"`

Changelog

11.0.0 (planned)

- add filter definitions database

Task

Group containing task tracking databases. Must be a child of a pipe group.

Struct Parameters

Parameter	Value
type	`"task"`

Group Parameters

Parameter	Value
name	`"task"`
label	`"Task"`

Mnemonic

Group containing mnemonic data databases. Must be a child of a pipe group.

Struct Parameters

Parameter	Value
type	`"mn"`

Group Parameters

Parameter	Value
name	`"mn"`
label	`"Mnemonic"`

Mnemonic Bin

Group containing binned mnemonic data databases. Must be a child of a mnemonic group.

Struct Parameters

Parameter	Value
type	`"mn_bin"`

Group Parameters

Parameter	Value
name	`"bin"`

Parameter	Value
label	"Bin"

Databases

Structs databases typically specify a set of required fields, and may permit the inclusion of additional custom fields. Changes to the spec involving fields will usually be treated as minor version changes, though they may require manual user correction if an added field conflicts with a custom field already present in a particular database instance.

Note that fields marked as **virtual** are calculated from the values of other field(s) and cannot be populated or edited manually.

Definitions

All definitions databases must be direct children of a definitions group, and all definitions groups must contain one of each definition database.

Diagram Definitions

Holds diagram definitions. The diagram itself is in an attached SVG file.

Struct Parameters

Parameter	Value
type	"def_diagram"

Database Parameters

Parameter	Value
name	"diagram"
label	"Diagram"
format	"{name}"
order	(name , desc)
singular	"diagram"

Fields

Name	Type	Req	Description
name	utf8vstring(128)	?	unique conf name
desc	utf8text		plain text description
file_name	utf8filename	?	file name
conf	jsonobject		diagram configuration

Name	Type	Req	Description
meta	`jsonobject`		additional metadata as needed

Changelog

11.0.0

- order changed to (`name`, asc)
- added `desc` field

Event Definitions

Holds event definitions, specifying how they are displayed, interpretted and processed. Filter Definition fields are defined in the `conf` field.

Struct Parameters

Parameter	Value
type	`"def_event"`

Database Parameters

Parameter	Value
name	`"event"`
label	`"Event"`
format	`"{name}"`
order	(`name`, asc)
singular	`"event definition"`

Fields

Name	Type	Req	Description
e_id	`int(4)`	?	unique ID
name	`utf8vstring(128)`	?	unique name
desc	`utf8text`		plain text description
meta	`jsonobject`		additional arbitrary metadata
conf	`jsonobject`		configuration for pseudo-events
aliases	`set(utf8string)`		alternative name(s)
ext_id	`asciivstring(64)`		external ID

Filter `conf` jsonobject

Name	Type	Req	Description
type	`utf8vstring(128)`	?	Must have a value of "filter"

Name	Type	Req	Description
condition	`utf8text`	?	filter condition expression
t_start_offset	`duration(us)`		start time offset (`0` if not provided)
t_end_offset	`duration(us)`		end time offset (`0` if not provided)
models	`set(asciistring)`		Models that the filter will apply to

Changelog

11.2.0

- added Filter `conf` specification (no structural change)

11.0.0

- added `aliases` field
- added `ext_id` field
- removed `type` field
- changed `e_id` type from `int(8)` to `int(4)`

Mnemonic Definitions

Holds mnemonic definitions, specifying how they are displayed, interpretted and processed.

Struct Parameters

Parameter	Value
type	`"def_mn"`

Database Parameters

Parameter	Value
name	`"mn"`
label	`"Mnemonic"`
format	`"{name} ({unit})"`
order	(`name`, asc)
singular	`"mnemonic definition"`

Fields

Name	Type	Req	Description
mn_id	`int(4)`	?	unique mnemonic ID
name	`utf8vstring(128)`	?	unique mnemonic name
subname	`utf8vstring(32)`		mnemonic sub-name

Name	Type	Req	Description
desc	`utf8text`		plain text mnemonic description
unit	`utf8vstring(32)`		measurement unit (for example, `"V"`, `"mA"`)
state	`struct_mn_state`	?	current state of mnemonic
pipes	`jsonobject`	?	map of model(s) to associated pipe(s)
full	`asciivstring(32)`		the primary database for the mnemonic, default `f8`
bin	`set(asciistring)`		the opt-in bin database(s) to include the mnemonic in
format	`asciivstring(32)`		printf-style format to render values
enums	`jsonobject`		mapping of permitted text values to numeric values
labels	`list(jsonobject)`		mapping of numeric values or ranges to labels
aliases	`set(utf8string)`		set of additional names associated with the mnemonic
meta	`jsonobject`		additional metadata as needed
query	`asciivstring(32)`		query name for pseudo-mnemonics
conf	`jsonobject`		configuration for pseudo-mnemonics
ext_id	`asciistring`		external ID

Changelog

11.0.0

- added `subname` field
- added `ext_id` field
- rename `origins` field to `pipes`

1.0.0

- `enum` changed to `enums` since "enum" is often a reserved keyword
- `meas` field removed (measure now assumed from `unit`)

Mnemonic Tracking

Used for tracking mnemonic selection activity. Although this is not strictly a definitions database, it is tightly coupled to the mnemonic definitions database, and is thus defined in the definitions context.

Struct Parameters

Parameter	Value
type	`"def_mn_track"`

Database Parameters

Parameter	Value
name	`"mn_track"`
label	`"Mnemonic Tracking"`
format	`"{t} {mn_id} {user}"`
order	(`name`, asc)
singular	`"mnemonic definition"`

Fields

Name	Type	Req	Description
t	`instant(us)`	?	time of selection
mn_id	`int(4)`	?	mnemonic ID selected
user	`user_id`	?	user taking action
mns	`set(int(4))`		other mnemonic ID(s) selected
models	`set(asciistring)`		model(s) in current context

Changelog

11.0.0 (planned)

- rename `mn_ids` to `mns`
- order changed to (`t`, desc)
- format changed to `"{t} {mn_id} {user}"`

Nominal Definitions

Holds mnemonic nominal range definitions.

Struct Parameters

Parameter	Value
type	`"def_nominal"`

Database Parameters

Parameter	Value
name	`"nominal"`
label	`"Nominal"`
format	`"{mn_id} {color} ({min}, {max}) {label}"`
order	(`mn_id`, asc), (`label`, asc)
singular	`"nominal definition"`

Fields

Name	Type	Req	Description
unid	`uuid`	?	unique nominal range ID
mn_id	`int(4)`	?	unique mnemonic ID
label	`utf8vstring(128)`	?	nominal range label
desc	`utf8text`		plain text nominal range description
color	`struct_nominal_color`		range color indicator
min	`float(8)`		min value for the range
max	`float(8)`		max value for the range
models	`set(asciistring)`		models for which this range should apply (all if `null`)
meta	`jsonobject`		additional metadata as needed

Notes

The `struct_nominal_color` type is an enum of **green** (0), **yellow** (1), and **red** (2).

Changelog

11.2.0

- added "meta" field

11.0.0

- renamed "nominal_id" to "unid"

Plot Configuration Definitions

Holds mnemonic plot configuration definitions.

Struct Parameters

Parameter	Value
type	`"def_plot"`

Database Parameters

Parameter	Value
name	`"plot"`
label	`"Plot Conf"`
format	`"{name}"`
order	(`name`, asc)
singular	`"plot configuration"`

Fields

Name	Type	Req	Description
name	`utf8vstring(128)`	?	unique conf name
desc	`utf8text`		plain text conf description
plot_conf	`struct_plot_conf`	?	configuration
models	`set(asciistring)`		models for which this conf should apply (any if `null`)

Changelog

11.0.0

- renamed field `conf` to `plot_conf` (to match profile definition)
- changed type of `plot_conf` from `jsonobject` to `struct_plot_conf`

Profile Definitions

Holds mnemonic profile definitions.

Struct Parameters

Parameter	Value
type	`"def_profile"`

Database Parameters

Parameter	Value
name	`"profile"`
label	`"Profile"`
format	`"{name}"`
order	(`name`, asc)
singular	`"profile"`

Fields

Name	Type	Req	Description
name	`utf8vstring(128)`	?	unique profile name
desc	`utf8text`		plain text profile description
models	`set(asciistring)`		models for which this conf should apply (all if `null`)
data_conf	`struct_data_conf`	?	profile data configuration
plot_conf	`struct_plot_conf`		profile plot configuration. If not provided, defaults to 1 mnemonic per plot, 1 plot per page.

Name	Type	Req	Description
auto_confs	`list(struct_auto_conf)`		automation configuration

`struct_data_conf` jsonobject

Name	Type	Req	Description
ids	`utf8text`		CSV range list of `mn_id`s e.g. `"1,2-10,100"` or `ext_id` formatted string e.g. `"@[1,4-8,12,100-200]sci;@[2,3]raw"`
filter	`jsonarray` of filter `jsonobject`s		List of filters to apply. Each filter object may reference an existing filter by name using the `filter` key, or directly provide a filter definition (the `type` and `models` fields are ignored). An `ids` key can be used to define which mnemonics the filter should apply to. If `ids` is not provided, then the filter will be applied to every mnemonic. Only one filter per mnemonic is currently supported.
limit	`boolean`		If `True`, generate the Limit Report. Defaults to `False`.
pkt	`boolean`		If `True`, export using Packet Time instead of Ground Receipt Time. Defaults to `False`. Ignored if the archives only contain 1 time source.
join	`boolean`		If `True`, the data file will be formatted with 1 unique time per row, and 1 mnemonic per column. Defaults to `False`.
fill	`boolean`		If `True` and `join` is `True`, empty cells will be populated with the most recent value. Defaults to `False`.
dis	`boolean`		If `True`, each mnemonic will also be exported using the Discrete conversion, if available. Defaults to `False`.
columns	`jsonobject`		Defines which columns are included in the data file.

`columns` jsonobject

Name	Type	Req	Description
date_utc	`boolean`		
ts_utc_iso	`boolean`		
ts_utc_excel	`boolean`		
ts_utc_excel_ms	`boolean`		

Name	Type	Req	Description
ts_utc_doy	boolean		
t_utc_unix_s	boolean		
t_utc_unix_ms	boolean		
t_utc_unix_us	boolean		
date_tai	boolean		
ts_tai_iso	boolean		
ts_tai_doy	boolean		
t_tai_unix_s	boolean		
t_tai_unix_ms	boolean		
t_tai_unix_us	boolean		
t_tai_tai_s	boolean		
t_tai_tai_ms	boolean		
t_tai_tai_us	boolean		
t_rel_s	boolean		
t_rel_ms	boolean		
t_rel_us	boolean		
name	boolean		
unit	boolean		

`plot_conf` jsonobject

See Export Plot Format

`struct_auto_conf` jsonobject

Note: The `auto_confs` field is a list of these described JSON objects.

Name	Type	Req	Description
daily	boolean		If `True`, the Profile will be exported once per day. Defaults to `False`.
mine	boolean		If `True`, the Profile will be exported during the Mining Task when any of the defined `intervals` are processed.
users	set(utf8vstring(128))		The list of NASA AUIDs to notify via email when the Daily Profile Export is generated

Notes

Requires review before use.

Changelog

11.0.0

- added `auto_conf`
- renamed field `data` to `data_conf`
- renamed field `plot` to `plot_conf`
- changed type of `plot_conf` from `jsonobject` to `struct_plot_conf`
- changed type of `data_conf` from `jsonobject` to `struct_data_conf`

Trend Definitions

Holds mnemonic trend definitions.

Struct Parameters

Parameter	Value
type	`"def_trend"`

Database Parameters

Parameter	Value
name	`"trend"`
format	`"Trend"`
order	(`name`, asc)
singular	`"trend definition"`

Fields

Name	Type	Req	Description
name	`utf8vstring(128)`	?	unique trend name
desc	`utf8text`		plain text trend description
profiles	`set(utf8string)`	?	profile name(s) to include in trend
models	`set(asciistring)`		models for which this trend should apply (any if `null`)
trend_conf	`struct_trend_conf`		trend configuration
plot_conf	`jsonobject`		Mapping of profile name to `struct_plot_conf` objects, alllowing you to override a Profile's plot conf.
auto_conf	`struct_auto_conf`		automated generation configuration

`struct_trend_conf` jsonobject

Name	Type	Req	Description

bin_size	`int(4)`		The bin size in minutes to use when trending time ranges
bin_count	`int(4)`		Multiplier of the `bin_size` to use when trending time ranges. The actual trended bin size in minutes is `bin_size` * `bin_count`.
t	array of time range JSON objects		List of JSON objects describing time ranges to trend e.g. `{"start": "2021-06-30T00:00:00Z", "end": "2021-07-21T00:00:00Z" }`
intervals	array of interval JSON objects		List of JSON objects describing Event Intervals to trend
disable_filter	`boolean`		If `True`, do not use any filtered data. Defaults to `False`.

`plot_conf` jsonobject

Allows the Trend Definition to override a Profile's plot configuration. In the below example, `FLT_CRIT_TEMPS` is a profile name. The plot configuration is the same format as the Profile's plot configuration.

```
{
 "FLT_CRIT_TEMPS": {
  "pages": [
   {
    "plots": [
     {
      "title": "Chamber Pressure",
      "mnemonics": [
       "oci.gse.ocl_pc.Pressure.hk.Chamber"
      ]
     }
    ]
   },
  ...
```

`struct_auto_conf` jsonobject

Name	Type	Req	Description
daily	`boolean`		If `True`, the Trend will be generated once per day. Defaults to `False`.
mine	`boolean`		If `True`, the Trend will be generated during the Mining Task when either the Time Range or Interval condition is satisfied.

Name	Type	Req	Description
users	`set(utf8vstring(128))`		The list of NASA AUIDs to notify via email when the Daily Trend is generated

Changelog

11.2.0

- added `models` field
- added `trend_conf` field
- added `auto_conf` field
- removed `intervals` field

11.0.0

- initial release

Files

Archive

Contains all archive files for a pipe. Must be a child of a pipe group.

Struct Parameters

Parameter	Value
type	`"file_archive"`

Database Parameters

Parameter	Value
name	`"archive"`
label	`"Archive"`
format	`"{t_start} {t_end}"`
singular	`"archive file"`

Fields

Name	Type	Req	Description
a_id	`int(4)`	?	archive ID
ufid	`uuid`	?	file UUID
t_start	`instant(us)`	?	start time of the time range that the file covers
t_end	`instant(us)`	?	end time of the time range that the file covers, not inclusive

Name	Type	Req	Description
dur	`duration(us)`	?	**virtual** `t_end` - `t_start`
t_min	`instant(us)`	?	time of first data in file
t_max	`instant(us)`	?	time of last data in file
file_name	`utf8filename`	?	archive file name
meta	`jsonobject`		additional metadata as needed
format	`asciivstring(32)`		file format: `xbin` or `xpf`, where `xpf` is a zipped dir (default `xbin`)
conf	`jsonobject`		configuration for format as needed

Changelog

11.0.0

- changed type from `"mn_file_archive"` to `"file_archive"`
- renamed `uuid` to `ufid`

Buffer

Contains all buffer files for a pipe. Must be a child of a pipe group.

Struct Parameters

Parameter	Value
type	`"file_buffer"`

Database Parameters

Parameter	Value
name	`"buffer"`
label	`"Buffer"`
format	`"{file_name}"`
singular	`"buffer file"`

Fields

Name	Type	Req	Description
ufid	`uuid`	?	file UUID
file_name	`utf8filename`	?	buffer file name
t_min	`instant(us)`	?	time of first data in file
t_max	`instant(us)`	?	time of last data in file
dur	`duration(us)`	?	**virtual** `t_max` - `t_min`

Name	Type	Req	Description
state	`struct_buffer_state`	?	buffer file state
flag	`struct_buffer_flag`		buffer file flag
meta	`jsonobject`		additional metadata as needed
format	`asciivstring(32)`		buffer file format (default `"csv"`)
conf	`jsonobject`		configuration for format as needed

Notes

The state field may be one of four values:

- `PENDING` - the file data is present in the mnemonic buffer database but has not been processed further
- `ARCHIVED` - the file contents have been distributed to the appropriate archive file(s)
- `DEPRECATED` - the file is preserved but no longer included in archive files

The flag field may be one of two values:

- `DEPRECATE` - the file is queued for deprecation
- `RESTORE` - the file is queued for restoration
- `DELETE` - the file is queued for deletion

Changelog

11.0.0

- changed type from `"mn_file_buffer"` to `"file_buffer"`
- renamed `uuid` to `ufid`
- removed `PROCESSED` state

CFT

Current filter table for a pipe. Stores a file for each archive containing the state of each filter at the end of the archive. Only created in pipes where `discrete` is `false`.

Struct Parameters

Parameter	Value
type	`"file_cft"`

Database Parameters

Parameter	Value
name	`"cft"`
label	`"CFT"`
format	`"{file_name}"`

Parameter	Value
singular	`"CFT file"`

Fields

Name	Type	Req	Description
a_id	`int(4)`	?	archive ID
ufid	`uuid`	?	file UUID
file_name	`utf8filename`	?	CVT file name
format	`asciivstring(32)`		CVT file format (default `"csv"`)
conf	`jsonobject`		configuration for format as needed

Changelog

11.0.0

- initial release

CVT

Current value table for a pipe. Stores a file for each archive containing the values for each mnemonic at the end of the archive. Only created in pipes where `discrete` is `false`.

Struct Parameters

Parameter	Value
type	`"file_cvt"`

Database Parameters

Parameter	Value
name	`"cvt"`
label	`"CVT"`
format	`"{file_name}"`
singular	`"CVT file"`

Fields

Name	Type	Req	Description
a_id	`int(4)`	?	archive ID
ufid	`uuid`	?	file UUID
file_name	`utf8filename`	?	CVT file name
meta	`jsonobject`		additional metadata as needed

Name	Type	Req	Description
format	`asciivstring(32)`		CVT file format (default `"csv"`)
conf	`jsonobject`		configuration for format as needed

Changelog

11.0.0

- initial release

Package

Stores generated export packages. Child of a model group.

Struct Parameters

Parameter	Value
type	`"file_package"`

Database Parameters

Parameter	Value
name	`"package"`
label	`"Package"`
format	`"{file_name}"`
singular	`"package file"`

Fields

Name	Type	Req	Description
t_start	`instant(us)`	?	start time
t_end	`instant(us)`	?	end time
a_id	`int(4)`		archive ID (if generated automatically)
ueid	`UUID`		UEID, if time range from event
label	`utf8vstring(128)`	?	package label
file_name	`utf8filename`	?	package file name
data_conf	`struct_data_conf`	?	data configuration
plot_conf	`struct_plot_conf`		plot configuration
auto_conf	`struct_auto_conf`		automation configuration
profile	`utf8vstring(128)`		profile name, if profile used
profile_version	`int(4)`		profile version, if profile used

Name	Type	Req	Description
meta	`jsonobject`		additional metadata as needed

Changelog

11.0.0

- initial release

Events

Event databases come in three forms, simple events, single file per event, and multiple files per event.

Event

Each record is a single event. May be a child of either a model or pipe group.

Struct Parameters

Parameter	Value
type	`"event"`

Database Parameters

Parameter	Value
name	* (default `"event"`)
label	* (default `"Event"`)
format	* (default `"{t_start} {event_id} {label}"`)
order	* (default (`t_start`, desc), (`event_id`, asc))
singular	* (default `"event"`)

Fields

Name	Type	Req	Virtual	Description
ueid	`uuid`	?		event UUID
e_id	`int(4)`	?		event ID (default to `0` if not provided)
a_id	`int(4)`	?		archive ID (only present if child of a pipe group)
t_start	`instant(us)`	?		start time
t_end	`instant(us)`			end time, not inclusive (if `null`, event is an open interval)
dur	`duration(us)`	?	?	duration in microseconds (`null` if open)

Name	Type	Req	Virtual	Description
interval	`boolean`	?	?	`t_start` != `t_end`
open	`boolean`	?	?	`t_end` is `null`
type	struct_event_type	?		event type (default to `message` if not provided)
level	`struct_event_level`	?		event level (default to `none` if not provided)
label	`utf8vstring(128)`	?		plain text label
content	`utf8text`			extended event content
meta	`jsonobject`			additional metadata as needed
conf	`jsonobject`			configuration for specific event types

Notes

Virtual fields are calculated from other fields and cannot be populated manually.

Changelog

11.0.0

- changed `uuid` to `ueid`
- changed `e_id` type from `int(8)` to `int(4)`
- removed `name` field
- added `a_id` field (when child of pipe group)

1.0.2

- corrected `t_end` and `dur` as not required

1.0.1

- corrected `name` as not required

1.0.0

- `pid` (primary ID) changed to `e_id` (event ID) to avoid confusion
- `sid` removed (additional IDs may be added as needed)
- `int` changed to `interval` (`int` is commonly reserved keyword)
- `dur`, `interval`, and `open` are now derived fields from `t_start` and `t_end`
- added `struct_event_type` and `struct_event_level` data types
- added `name` as event definition association

Event File

Uses same structure as event database, with one additional field.

Database Parameters

Parameter	Value
name	* (default `"eventf"`)
label	* (default `"Event File"`)
singular	* (default `"event file"`)

Name	Type	Req	Description
file_name	`utf8filename`	?	file name

Event Files

Uses same structure as event database, but with a child file database, allowing each event to contain zero or more files.

Database Parameters

Parameter	Value
name	* (default `"eventfs"`)
label	* (default `"Event Files"`)
singular	* (default `"event files"`)

Event Update

Captures updates to events as records.

Struct Parameters

Parameter	Value
type	`"event_update"`

Database Parameters

Parameter	Value
name	`"{name}_update"`)
label	`"{label} Update"`
format	`"{t_start} {ueid} {label}"`)
order	(`t`, desc)
singular	`"event change"`

Fields

Name	Type	Req	Description
t	`instant(us)`	?	event change time
ueid	`uuid`	?	event UUID

Name	Type	Req	Description
update	`jsonobject`	?	field(s) to update

Changelog

11.0.0

- initial release

Mnemonics

Databases containing mnemonic data. Unless otherwise indicated, mnemonic databases can be configured with a partitioning system which subdivides the tables internally into UTC calendar months. This is beneficial for selective mnemonic data repopulation, since each month can be instantly erased before being regenerated, and doesn't require downtime of the entire dataset. At creation time a start and end year must be specified, and partitions will be created for each month in that range. Data with timestamps outside the range will be stored in either a pre-range or post-range partition as applicable.

Mn Buffer

Each record is a single mnemonic data point. Holds data imported through the buffer pipeline. Unlike other mnemonic databases, may contain duplicate data points.

This database does not hold data indefinitely. The automated archive pipeline will remove data as it is archived and mined into the primary mnemonic databases.

Struct Parameters

Parameter	Value
type	`"mn_buffer"`

Database Parameters

Parameter	Value
name	`"buffer"`
label	`"Buffer"`
format	`"{t} {mn_id} {v}"`
singular	`"mnemonic buffer datapoint"`

Fields

Name	Type	Req	Description
t	`instant(us)`	?	time
mn_id	`int(4)`	?	unique mnemonic ID
v	`{conf.type}`		value

Mn Full

Each record is a single mnemonic data point. The data type for mnemonic values is configurable, and determines the database name. By default the mnemonic data group will contain a full `float(8)` database.

Struct Parameters

Parameter	Value
type	`"mn_full"`

Conf Parameters

Parameter	Value	Default
type	`"int(1)"`, `"int(2)"`, `"int(4)"`, `"int(8)"`, `"float(4)"`, or `"float(8)"`	`"float(8)"`

Database Parameters

Parameter	Value
name	`"i1"`, `"i2"`, `"i4"`, `"i8"`, `"f4"`, or `"f8"`
label	`"Full <conf.type>"`
format	`"{t} {mn_id} {v}"`
singular	`"mnemonic datapoint"`

Fields

Name	Type	Req	Description
a_id	`int(4)`	?	archive ID
t	`instant(us)`	?	time
mn_id	`int(4)`	?	unique mnemonic ID
v	`{conf.type}`		value

Changelog

11.0.0

- added `a_id`

Mn Delta

An optimized mnemonic storage solution with each record representing one or more mnemonic data points, by only including points where the mnemonic value actually changes. The value data type is customizable, as with the Mn Full database. By default the mnemonic data group will contain a delta `float(8)` database.

Struct Parameters

Parameter	Value
type	`"mn_delta"`

Conf Parameters

Parameter	Value	Default
type	`"int(1)"`, `"int(2)"`, `"int(4)"`, `"int(8)"`, `"float(4)"`, or `"float(8)"`	`"float(8)"`

Database Parameters

Parameter	Value
name	`"di1"`, `"di2"`, `"di4"`, `"di8"`, `"df4"`, or `"df8"`
label	`"Delta {conf.type}"`
format	`"{t} {mn_id} {v} ({n})"`
singular	`"mnemonic delta datapoint"`

Fields

Name	Type	Req	Description
a_id	`int(4)`	?	archive ID
t	`instant(us)`	?	time
mn_id	`int(4)`	?	unique mnemonic ID
v	`{conf.type}`		value
n	`int(4)`	?	number of datapoints included in this point

Changelog

11.0.0

- added `a_id`

Mn Bin Time

Contains mnemonic data binned on fixed time intervals. By default these will be created for 1 minute (`"t60"`) and 10 minute (`"t600"`) bin sizes.

Struct Parameters

Parameter	Value
type	`"mn_bin_time"`

Conf Parameters

Parameter	Value
t	bin size in seconds

Database Parameters

Parameter	Value
name	`"t<conf.t>"`
label	`"Time (<conf.t>s)"`
format	`"{t} {mn_id} {avg} ({min}, {max})"`
singular	`"mnemonic bin"`

Fields

Name	Type	Req	Description
a_id	`int(4)`	?	archive ID
t	`instant(us)`	?	start time of the bin
mn_id	`int(4)`	?	unique mnemonic ID
t_min	`instant(us)`	?	time of first datapoint
t_max	`instant(us)`	?	time of last datapoint
n	`int(4)`	?	number of datapoints in bin
avg	`float(8)`	?	average
min	`float(8)`	?	min
max	`float(8)`	?	max
std	`float(8)`	?	sample standard deviation

Changelog

11.0.0

- added `a_id` field
- removed `med` and `var` fields

Mn Bin Interval

Contains mnemonic data binned by interval events.

Struct Parameters

Parameter	Value
type	`"mn_bin_interval"`

Database Parameters

Parameter	Value
name	`"interval"`
label	`"Interval"`
format	`"{t} {e_id} {mn_id} {avg} ({min}, {max})"`
singular	`"mnemonic bin"`

Fields

Name	Type	Req	Description
a_id	`int(4)`	?	archive ID
ueid	`uuid`	?	
e_id	`int(8)`	?	
t_start	`instant(us)`	?	start time
t_end	`instant(us)`	?	end time
mn_id	`int(4)`	?	unique mnemonic ID
t_min	`instant(us)`	?	time of first datapoint
t_max	`instant(us)`	?	time of last datapoint
n	`int(4)`	?	number of datapoints in bin
avg	`float(8)`	?	average
min	`float(8)`	?	min
max	`float(8)`	?	max
std	`float(8)`		sample standard deviation

Changelog

11.0.0

- added `a_id` field
- renamed field `uuid` to `ueid`
- removed `med` and `var` fields

Mn Bin Edge

Contains mnemonic data binned on archive boundaries and cross-archive interval event boundaries. Used to generate interval bins efficiently for cross-archive interval events. Only created in pipes where `discrete` is `false`.

Struct Parameters

Parameter	Value
type	`"mn_bin_edge"`

Database Parameters

Parameter	Value
name	`"edge"`
label	`"Edge"`
format	`"{t_start} - {t_end} {mn_id} {avg} ({min}, {max})"`
singular	`"mnemonic bin"`

Fields

Name	Type	Req	Description
a_id	`int(4)`	?	archive ID
t_start	`instant(us)`	?	start time
t_end	`instant(us)`	?	end time
mn_id	`int(4)`	?	unique mnemonic ID
t_min	`instant(us)`	?	time of first datapoint
t_max	`instant(us)`	?	time of last datapoint
n	`int(4)`	?	number of datapoints in bin
avg	`float(8)`	?	average
min	`float(8)`	?	min
max	`float(8)`	?	max
std	`float(8)`	?	sample standard deviation

Changelog

11.0.0

- initial release

Tasks

Store logs and associated files for data processing tasks.

Condense

Each record logs a single execution of a condense task.

Struct Parameters

Parameter	Value
type	task_condense

Database Parameters

Parameter	Value
name	`"condense"`
label	`"Condense"`
format	`"{task_id} {t}"`
singular	`"condense task"`

Fields

Name	Type	Req	Description

task_id	`task_id`	?	unique task ID
t	`instant(us)`	?	time when task submitted
meta	`jsonobject`		additional metadata as needed
conf	`jsonobject`		task configuration
condensed	`list(jsonobject)`		buffer file(s) condensed

Mine

Each record logs a single execution of a mine task.

Struct Parameters

Parameter	Value
type	task_mine

Database Parameters

Parameter	Value
name	`"mine"`
label	`"Mine"`
format	`"{task_id} {t_start}"`
singular	`"mine task"`

Fields

Name	Type	Req	Description
task_id	`task_id`	?	unique task ID
t	`instant(us)`	?	time when task submitted
ufid	`uuid`	?	source archive file UUID
t_start	`instant(us)`	?	source archive file start time
t_end	`instant(us)`	?	source archive file end time
meta	`jsonobject`		additional metadata as needed
conf	`jsonobject`		task configuration

Changelog

11.0.0

- renamed `uuid` to `ufid`

Archive

Each record logs a single execution of an archive task.

Struct Parameters

Parameter	Value
type	task_archive

Database Parameters

Parameter	Value
name	`"archive"`
label	`"Archive"`
format	`"{task_id} {t}"`
singular	`"archive task"`

Fields

Name	Type	Req	Description
task_id	`task_id`	?	unique task ID
t	`instant(us)`	?	time when task submitted
meta	`jsonobject`		additional metadata as needed
conf	`jsonobject`		task configuration
archives	`list(jsonobject)`		archives updated
archived	`list(jsonobject)`		buffer file(s) archived
restored	`list(jsonobject)`		buffer file(s) restored
deprecated	`list(jsonobject)`		buffer file(s) deprecated
deleted	`list(jsonobject)`		buffer file(s) deleted

Spectra

The spectra definition is a property for event databases.

Property	Value	Req	Description
tabs	array of tab conf(s)		custom tabs for UI
presearch	array of presearch confs		custom pre-search components for UI
filters	array of filter confs		
grouping	array of field name(s)		
charts	charts conf	?	
tables	array of table conf		
query	query conf		
labels	labels conf		

Spectra Tab Conf

Configuration for a spectra search tab. This may be a `string`, referencing the name of a custom tab implementation, or an object with a `"type"` property specifying a tab type and additional properties applicable for that type. Currently there are no custom tab types, but they may be added in the future.

Spectra Database Tab

Under Construction

The database tab employs a record search for a separate target database of any type, and a solution for converting a selection from the target database to the spectra database.

Property	Value	Req	Description
type	`"database"`	?	tab type name
database	database specifier	?	target database specifier
map	see below	?	solution to map target selection to spectra selection

The `"map"` property may be a `string`, `array` of `strings`, or `object`.

If a `string`, the value must be the name of a custom selection function (none currently exist, they may be added in the future).

Spectra Presearch Conf

Specifies a set of components to display before the main spectra search component.

Spectra Field Presearch

Specifies a standalone component to search a particular field.

Property	Value	Req	Description
type	`"field"`	?	presearch type name
field	field specifier	?	
options	see below		options for search dropdown

Spectra Filters Conf

Specifies filters / badges for spectra search.

Property	Value	Req	Description
name	`string`	?	system name for filter
label	`string`		display label (uses name if absent)
badge	`string`		badge label (uses name if absent)
desc	`string`		description for badge / filter tooltip

Property	Value	Req	Description
color	`string`		color code or CSS class
e	`expression`	?	expression to apply for filter

Spectra Charts Conf

Specifies options for each spectra chart.

Property	Value	Req	Description
summary	spectra chart conf	?	summary chart conf
spectra	spectra chart conf	?	spectra chart conf

Spectra Chart Conf

Specifies options for a single spectra chart.

Property	Value	Req	Description
x	`string[]`	?	x axis options
y	`string[]`	?	y axis options
tooltip	`string`		record format string

Spectra Tables Conf

Under Construction

Spectra Query Conf

Under Construction

Spectra Labels Conf

Labels are specified as an `object` mapping standard label values to custom values. These will be defined as needed.

Name Conventions Reference

Structs definition names have certain requirements and optional conventions, unless otherwise indicated.

Names are limited to **128 characters** and may not include the following reserved characters:

- `&` (ampersand)
- `!` (excalamation point)
- `?` (question mark)
- `$` (dollar sign)
- `:` (colon)
- `;` (semicolon)
- `#` (number symbol)
- `*` (asteriks)
- `@` (at symbol)
- `,` (comma)
- `(` (open parentheses)
- `)` (close parentheses)
- `{` (open brace)
- `}` (close brace)

In cases where names are used by API actions to lookup definitions, the `@` character may be used to indicate an external ID instead of a plain name.

For matching purposes names are **case insensitive** and **normalized** with any leading/trailing whitespace removed and any internal whitespace represented by a single underscore character. For example:

```
"v_mon" = "V  Mon" = " V MON "
```

XINA tools will interpret the period character (`.`) to indicate a tree structure relationship, and brackets (`[]`) to indicate an array of values. This is entirely presentational, not functional.

For example, the set of names:

```
foo.bar
foo.baz.bit
foo.arr[0]
foo.arr[1]
foo.arr[2]
```

Would be displayed as:

- `foo`
  - `bar`
  - `baz`
    - `bit`
  - `arr[]`

- `arr[0]`
- `arr[1]`
- `arr[2]`

This is not required but highly recommended to improve organization in large namespaces.

Units Reference