PARAMETER MANAGEMENT: SOLVED

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WHY ARE WE HERE

- <u>We want to make parameter tracking as effortless and accurate as possible</u>
- Parameter definition and versioning is a critical and recurring problem
- ICDs (Interface Control Document) change over time and may not match existing software or configuration
- ICDs are delivered and stored in a variety of formats such as PDF, Word, and CSV
- ICDs are often versioned along the lines of "v3-final-final.pdf"

THE ORIGINAL PROBLEM

- Need for real-world parameter definitions in YAML for TIP (shown in later slides)
- Existing and accessible data available in CSV from DPS (shown later)
- A simple command-line tool was developed and a simple, extensible "parameter" data model emerged
- Converting to/from this model made CSV to YAML (the name of the tool) simpler
- The inverse is also true, any given format merely needs a "read" (to a Parameter object) and "write" function to become interoperable with all other supported formats.
- Original MVP (Minimum Viable Product) was under 200 lines of Python code

TIP – TRANSLATE, INGEST, PARSE

- "Government open-source" project out of the 309th SWEG at Hill AFB
- Part of their OPAL (Open Platform for Advanced Learning) development effort
- Takes raw Chapter 10 data and an ICD in YAML format
- Rapidly produces data in parquet format (suitable for modern cloud computing)
- Data is EU-converted (feet, degrees, etc.)
- Supports several of the most critical formats (1553, Arinc 429, Video) with others being added
- Can run natively in Linux as well as in a containerized fashion

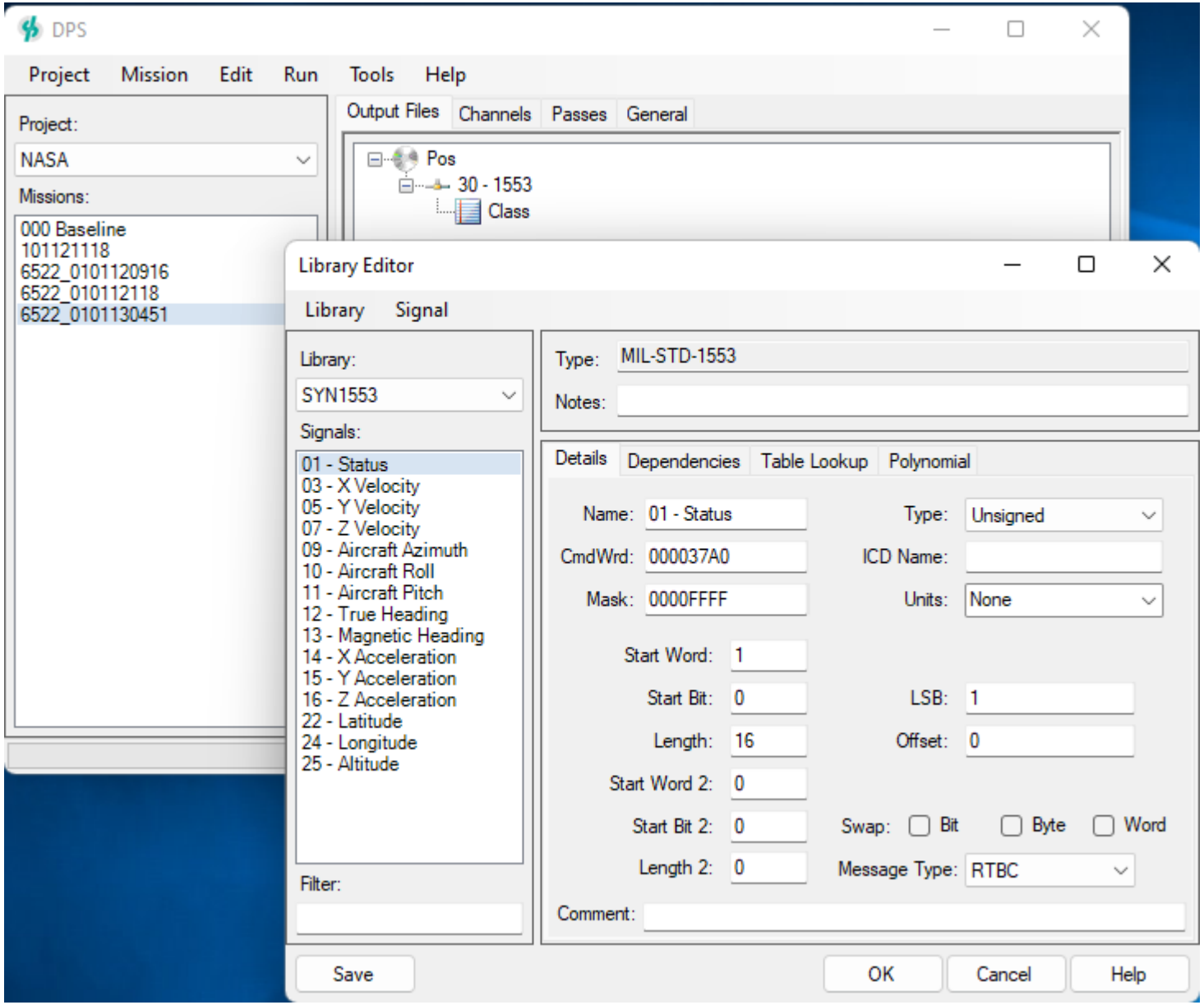
TIP YAML FORMAT

- Defines channel->message information
- Defines parameter specifics (offset, etc)
- Defines EU conversion

```yaml
translatable_word_definitions:
 TestWord:
    wrd_data:
      label: 107
      bus: 5
      sdiusd: false
      sdi: 2
      rate: 1.1
      desc: 'Test'
      lru_name: 'LRU921'
    elem:
      107_alt:
        schema: UNSIGNEDBITS
        msbval: 1.0
        lsb: 11
        bitcnt: 8
        desc: 'Altitude'
        uom: 'FT'
        class: 0
```

DPS

- Commercially available program for processing Chapter 10 data and producing a variety of output formats including CSV
- Flat-file format for importing parameter definitions
- Includes ability to import/export definitions in TMATS



DPS CSV FORMAT

- Defines parameter position and EU conversion
- Doesn't currently provide channel information

Name		ICD Name	Record Ide	Mask	Units	Start Wor	Start Bit	Length	Start Wor	Start Bit 2	Length 2	Type	9th Or
01 - Status	0		000037A0	0000FFFF	None	1	0	16	0	0	0	Unsigned	
03 - X Velocity	0		000037A0	0000FFFF	Feet/Secc	3	0	16	4	0	16	Two's Complement	
05 - Y Velocity	0		000037A0	0000FFFF	Feet/Secc	5	0	16	6	0	16	Two's Complement	
07 - Z Velocity	0		000037A0	0000FFFF	Feet/Secc	7	0	16	8	0	16	Two's Complement	
09 - Aircraft Azimuth	0		000037A0	0000FFFF	DEG	9	0	16	0	0	0	Two's Complement	
10 - Aircraft Roll	0		000037A0	0000FFFF	DEG	10	0	16	0	0	0	Two's Complement	

THE PARAMETER DATA MODEL

- Name
- Description
- Unit of Measure
- Word Offset
- Message Type (1553: RT-BC, etc.)
- Bit Offset
- Bit Length
- Data Type
- Linear Transform
- Bus (channel)
- Key (1553 command word, ARINC label, etc.)
- Secondary Key

PMT GENERAL DESIGN

- Data served by a REST API backed by a database (can be sqlite, postgres, etc.)
- The API allows other services or applications to work from the same set of parameter definitions for consistency
- Browser based frontend allows for easy management and import/export
- Could easily be adapted to mobile/native desktop uses
- Import/export formats can easily be added or changed
- All components can be deployed on bare metal or in a containerized fashion
- As a proof of concept, all components are tested against IronBank approved container images

API RESOURCES/ENDPOINTS

- /parameters – resource for managing parameters
- /icds – resource for managing ICD versions
- /attachments – resource for managing ICD attachments (CSV, YAML, PDF, etc.)
- /formats – lists parameter definition formats supported by a given instance
- /export – endpoint for exporting parameters to a given format

PARAMETERS TAB

- Shows table of parameters with full CRUD (create/read/update/delete) interface
- Supports rapid text or column-based search
- Can be filtered by ICD revision (more later)

Parameter Management Tool

PARAMETERS ICDS

Parameters (13,734)

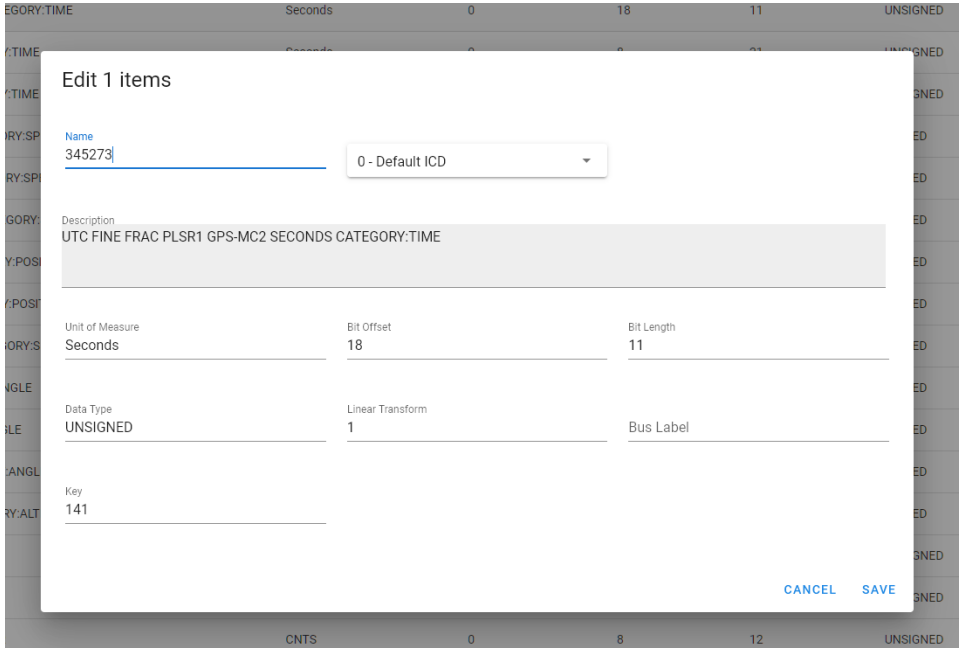
Search... Try <column>:value to search specific colum...

2 - Updates

ADD

name	icd	description	unit_of_measure	word_offset	bit_offset	bit_length	data_type	linear_transform	bus	key	msg_type
345275	2 - Updates	Random edit	HR	0	11	6	UNSIGNED	1		150	
345274	0 - Default ICD	UTC MINUTES PLSR1 GPS-MC2 MIN CATEGORY:TIME	HR	0	17	6	UNSIGNED	1		150	
345273	0 - Default ICD	UTC FINE FRAC PLSR1 GPS-MC2 SECONDS CATEGORY:TIME	Seconds	0	18	11	UNSIGNED	1		141	
345272	0 - Default ICD	UTC FINE PLSR1 GPS-MC2 SECONDS CATEGORY:TIME	Seconds	0	8	21	UNSIGNED	1		140	
345271	0 - Default ICD	UTC HOURS PLSR1 GPS-MC2 HOURS CATEGORY:TIME	HR	0	23	5	UNSIGNED	1		150	

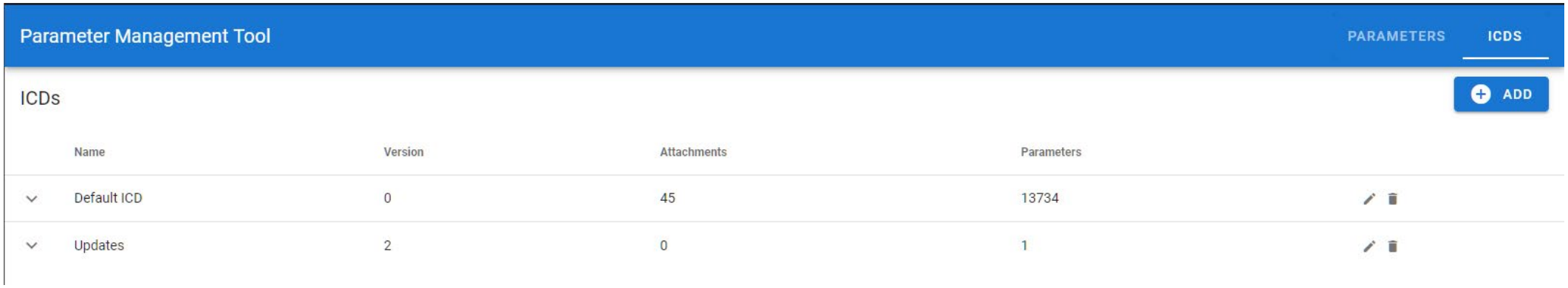
ADDING/EDITING PARAMETERS



Supports single or multi-edit

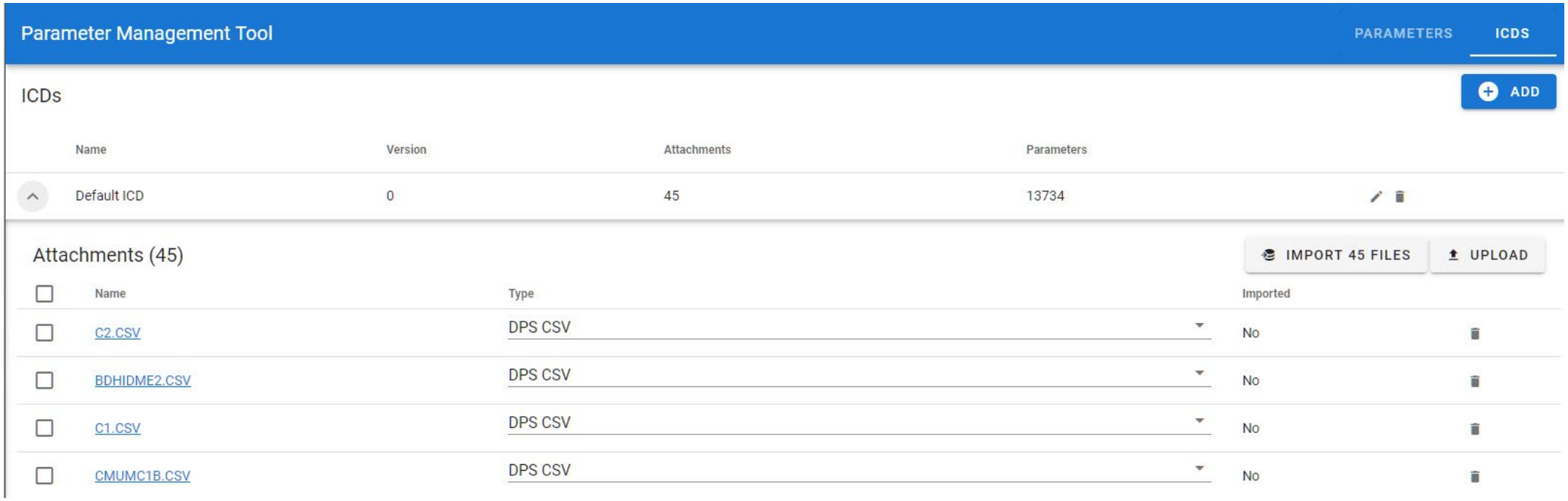
ICD TAB

- Management of different ICD versions
- Attachment management



ADD/EDIT ICD ATTACHMENTS

- Attachments can be importable (such as DPS CSV, TIP YAML, or a custom type)
- Attachments can also be non-importable (such as PDF, Word, etc.) for reference
- Attachments belong to an ICD version ("Default ICD" in this case)



PARAMETER IMPORT

- From the ICD page, one or more attachments can be flagged for import
- On the import page (shown) some or all found parameters can be imported
- Unsupported features are displayed as warnings prior to import in order to prevent data loss

Parameter Management Tool

PARAMETERS ICDS

Import Parameters

Warnings (1)

Command word masks aren't automatically converted yet.

Parameters Found (18)

IMPORT ALL CANCEL

Name	Description	Unit of Measure	Word Offset	Bit Offset	Bit Length	Data Type	Linear Transform	Bus	Key	Message Type
S9NT01	TRUE N TRACK ANGLE MCK2-CCU2 DEG CATEGORY:ANGLE	None	8	0	16	SIGNED	0.005493168		0000B740	RTBC
S9NT02	TRACK ANGLE RATE MCK2-CCU2 SEMICIRCLES/SEC CATEGORY:RATE	None	10	0	16	SIGNED	0.0006103512		0000B740	RTBC
S9NT03	GROUND SPEED KNOTS CATEGORY:SPEED	None	10	0	16	SIGNED	0.03125		0000B740	RTBC

PARAMETER SEARCH

Parameters can be searched using simple text matching

Parameter Management Tool

PARAMETERS ICDS

Parameters (72) altitude RESET 2 - Updates ADD

name	icd	description	unit_of_measure	word_offset	bit_offset	bit_length	data_type	linear_transform	bus	key	msg_type
345251	0 - Default ICD	ALTITUDE(MSL) PLSR1 GPS-MC2 FEET CATEGORY:ALTD	Feet	0	8	21	SIGNED	0		076	
345006	0 - Default ICD	ALTITUDE SELECT LIMIT B FT CATEGORY:DISCR	Feet	0	17	7	UNSIGNED	100		013	
345005	0 - Default ICD	ALTITUDE SELECT LIMIT A FT CATEGORY:DISCR	Feet	0	10	7	UNSIGNED	100		013	

Or by column

Parameter Management Tool

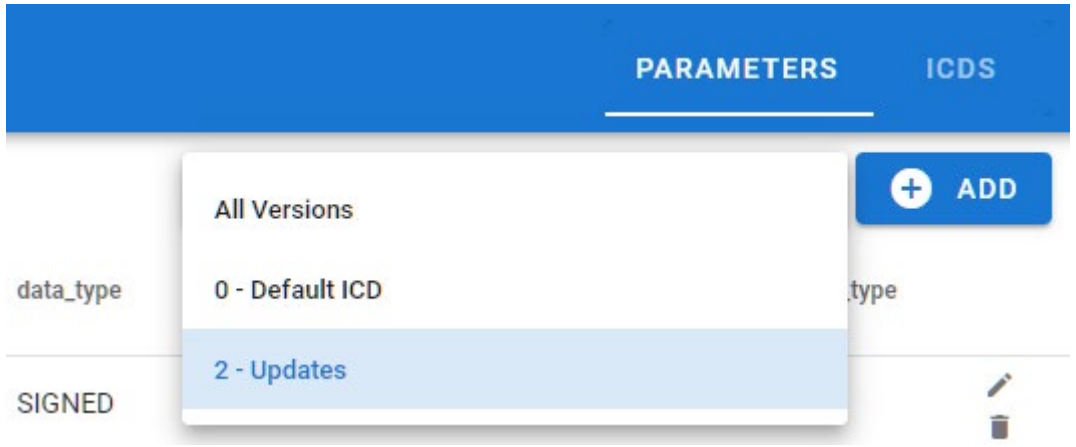
PARAMETERS ICDS

Parameters (26) unit_of_measure:knots RESET 2 - Updates ADD

name	icd	description	unit_of_measure	word_offset	bit_offset	bit_length	data_type	linear_transform	bus	key	msg_type
345263	0 - Default ICD	E/W VELOCITY PLSR1 GPS-MC2 KNOTS CATEGORY:SPEED	KNOTS	0	13	16	SIGNED	0		174	
345262	0 - Default ICD	N/S VELOCITY PLSR1 GPS-MC2 KNOTS CATEGORY:SPEED	KNOTS	0	13	16	SIGNED	0		166	
345255	0 - Default ICD	GROUND SPEED PLSR1 GPS-MC2 KNOTS CATEGORY:SPEED	KNOTS	0	13	16	SIGNED	0		110	

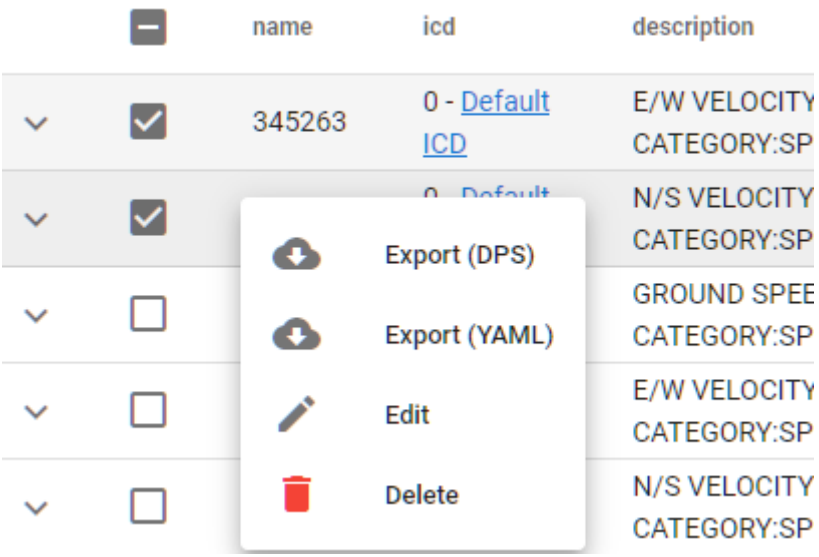
PARAMETER CASCADE

- By default, the most recent ICD version is shown
- Unchanged parameters defined in an earlier version will "cascade" and be shown in the later version
- Specific versions, or all versions may be displayed if the user wishes



PARAMETER EXPORT

- Some or all parameters can easily be exported to any supported type



PLANNED FEATURES

- TMATS support
- DPS integration
- Audit log
- Support for industry and DoD standard access controls