GPower

Acquiring Data, You Can Trust

Datalogging with precision in every sample

Rev 1.0

27.10.2025

About me

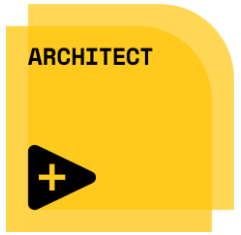
GPower

Name Jens Christian Østergaard Andersen

Location Denmark

Work for GPower since 2015

LabVIEW since 1998



About GPower

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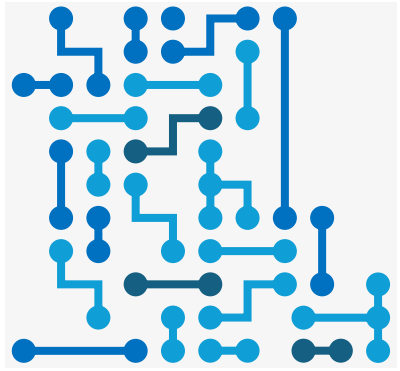
WHY ARE WE DIFFERENT THAN THE REST?



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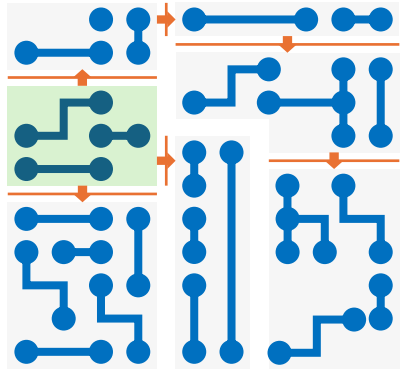


MODULAR

One Team

You might just meet one consultant…

…but you get the whole team. Our weekly kickoffs, the daily scrum, design sessions, reviews, and tech meetings brings more than a decade of experience into your project

Industrial Grade Systems

Our solutions are designed to save you time and money

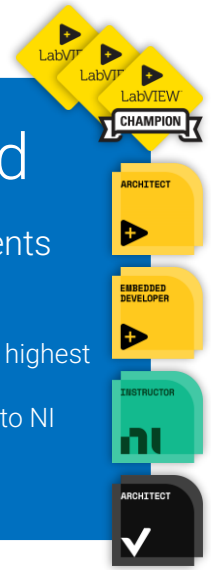
Quality can not be added later; it must be built in from the start. We care, we know how to do it, and we go the extra mile to deliver that next level quality to you every time.

Modular systems are maintainable, reliable systems are dependable, and clever design is cost efficient to scale.

NI Connected

Not just a National Instruments partner

With 3 LabVIEW Champions and the highest global concentration of product certifications we have direct access to NI R&D, NI product owners, and NI leadership.



Topics

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1. We built a datalogger, but why?
2. Real world system example
3. Data quality
4. Datalogger software design
5. Questions and wrap-up

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We built a datalogger, but why?

Are we crossing the river to get water?

We built a datalogger, but why?

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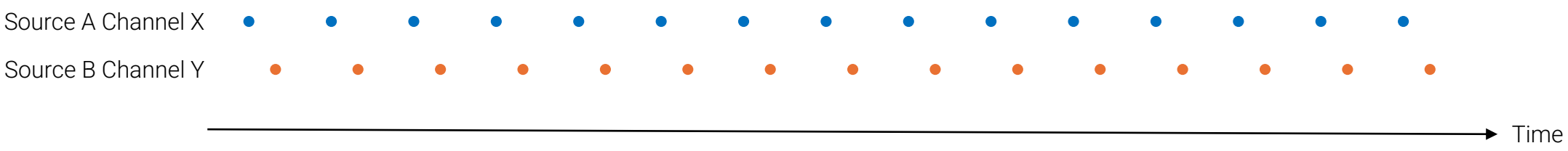
Data Concurrency

Issues with concurrency of data between channels with same data rate but different sample sources.



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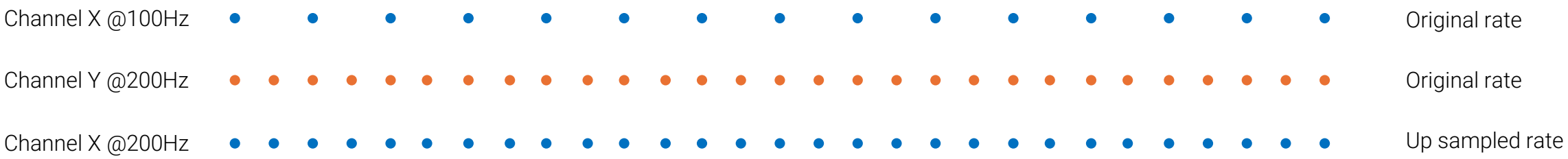
Multiple Rate Channels

Missing ability to acquire data from one channel at multiple data rates.



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Everyday trivialities in data acquisition systems, but no good solutions available in the market.

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Real world system example

From the GPower backlog…

Real world system example

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Measurement channels requirements

12 voltages channels spread across 4 cDAQ chassis.

Data rate: 1kHz.

12 voltage channels + 12 current channels + 3 vibration channels from one cDAQ chassis.

Data rate: 10kHz.

2 speed measurements read from a web server using REST.

Data rate 25 Hz

Several other channels read from the same web server.

Data rate 1Hz.

Several channels read from a PLC using OPC UA.

Data rate between 1Hz and 10Hz.

Othe system requirements

Run continually and without a user interface.

Provide an API for remote control.

Stand-alone user application which can:

- Connect to the system..
- Obtaining system status.
- Start / stop the acquisition.
- Show live data.
- Reconfigure the system.

Option for control from NI TestStand.

Data output to TDMS files.

Real world system example – Implementations focus points

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Modularity

On the top level we build the system as plugin-based architecture, but we build for modularity on all levels of the system.

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Acquire from one to multiple channels and distribute the acquisition across multiple computers if needed.

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Provides the opportunity to sit in your office and create a system configuration without access to the hardware.

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High Data Quality

High data quality is paramount to the success of any data acquisition system.

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Data Quality

Definition, importance, cause and solution

What defines data quality?

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Timing

Common understanding of time between data sets. ✓

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Timing

Common understanding of time between data sets.

Completeness

Complete data sets every time. ✓

Why is data quality important?

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Cause and effect

If the data quality is bad, there is high risk of getting the order of evets wrong.

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Frequency analysis

If you have data bins which are supposed to contain 1000 samples each, but sometimes they contain 998 samples and sometimes 1001 you have a problem.

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Frequency analyses

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Calculated channels

If you need to create channels based on calculations with data from other channels you need to know that you can trust the data used in the calculations.

What causes bad data quality?

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Missing data

Unplugged network cable, defect or unconfigured subsystem etc.

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Mixed data rates

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Data out of phase

Data from different channels with same data rate but different phase.

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Data out of phase

Data from different channels with same data rate but different phase.

Periodic vs aperiodic

Missing awareness about handling periodic vs aperiodic data.

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Missing data strategy

Decide on a solid strategy for handling missing data to avoid an unstable DAQ system.

How to ensure good data quality? – Missing data strategy

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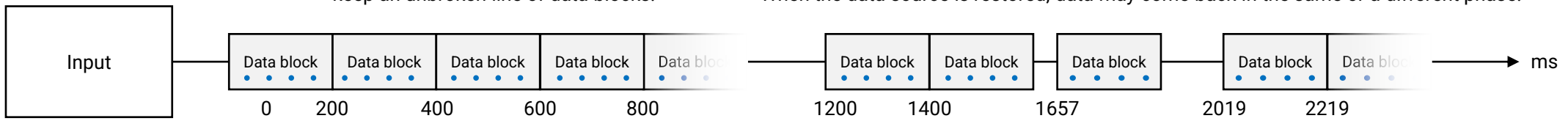
1) There can be gabs in the line of input data blocks and they may vary in phase.

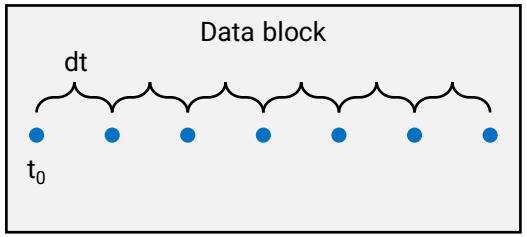
The Input module must attempt to keep an unbroken line of data blocks:

…but if there are fallouts in the data source gabs may occur in the line of data blocks. When the data source is restored, data may come back in the same or a different phase.

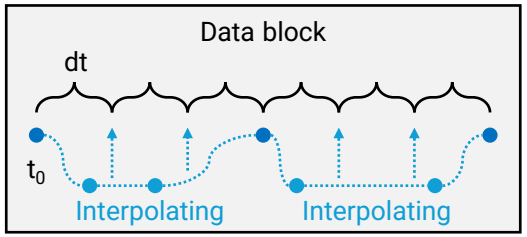


2) If input data is missing the input module must fill out the data blocks.

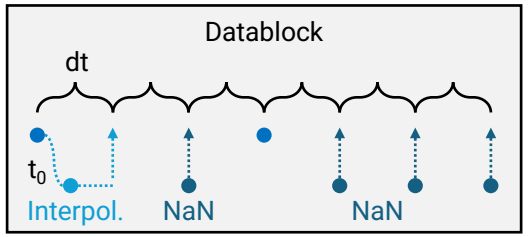
These scenarios can occur if the data source is unstable or ran out of data.



Data blocks from the same source must always contain the same number of data values.



If the data values are out of phase with dt, we must do interpolation.



If data values are missing, we need to fill in with NaN. (no extrapolation).

3) Data blocks must always be sent out in ascending time order.

4) Data blocks must never overlap in time.

How to ensure good data quality?

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Missing data strategy

Decide on a solid strategy for handling missing data.

Resampling

Resample data which you need to used in the same calculations to a common data rate to ensure all calculations are done in the same time domain.

How to ensure good data quality? – Resampling

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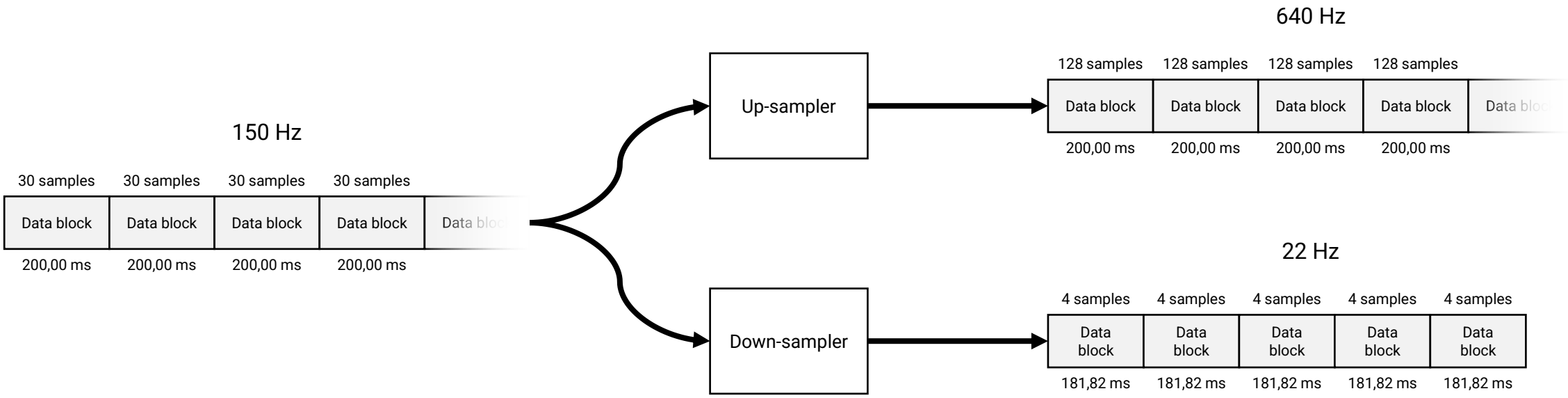
All data blocks in the primary input data are complete (possible with interpolated values or NaN's in place of missing input data). There can of cause be gabs between the data blocks and they are not guarantied to follow the same phase.

When up-sampling **extrapolation** of data will be needed.
If we have NaN's, gabs or phase shift in the primary input data we will also have NaN's, gabs and phase shift in the up-sampled input data.



When down-sampling interpolation of data will be needed.
If we have NaN's, gabs or phase shift in the primary input data we will also have NaN's, gabs and phase shift in the down-sampled input data.

How to ensure good data quality?

GPower

Missing data strategy

Decide on a solid strategy for handling missing data.

Resampling

Resample data which you need to used in the same calculations to a common data rate to ensure all calculations are done in the same time domain.

Adjust phase

Group data with common data rate and make sure they are adjusted to the same phase.

How to ensure good data quality? – Adjustment phase

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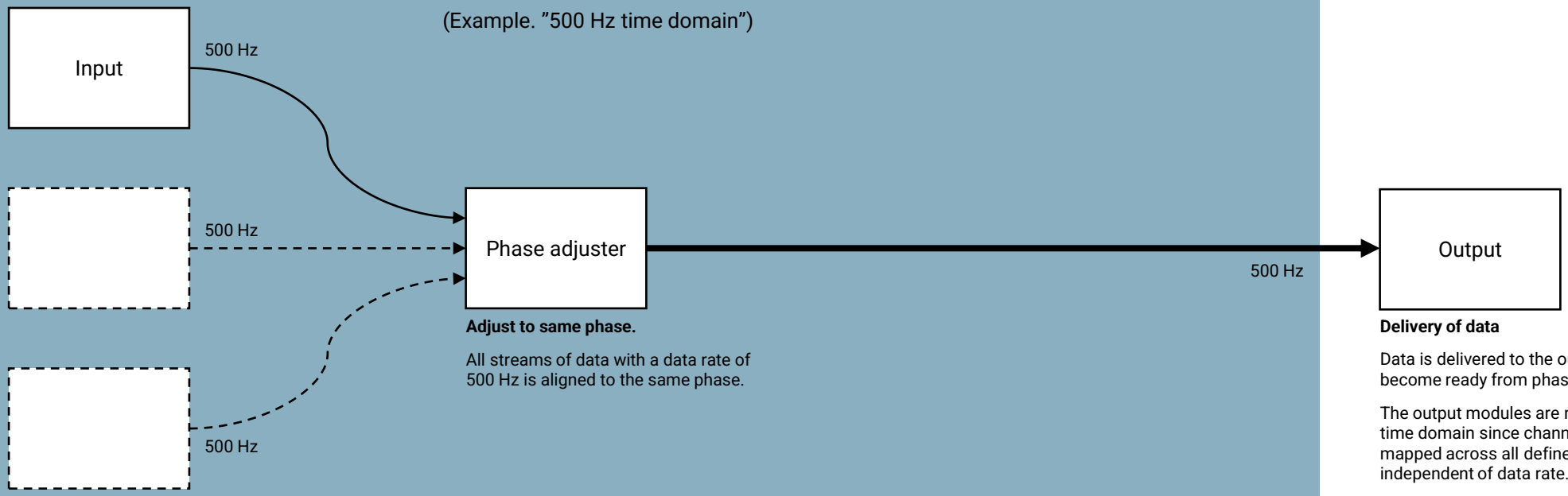
Grouping in time domains: All streams of data with the same data rate must be handled in the same time domain



Adjust to same phase.

All streams of data with a data rate of 500 Hz is aligned to the same phase.

Delivery of data

Data is delivered to the outputs as they become ready from phase adjuster.

The output modules are not part of the time domain since channels can be mapped across all defined outputs independent of data rate.

How to ensure good data quality?

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Decide on a solid strategy for handling missing data.

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Resample data which you need to used in the same calculations to a common data rate to ensure all calculations are done in the same time domain.

Adjust phase

Groupe data with common data rate and make sure they are adjusted to the same phase.

Periodic vs aperiodic

Learn how to properly handle non-periodic signals when building your DAQ software.

How to ensure good data quality? – Periodic vs aperiodic signals

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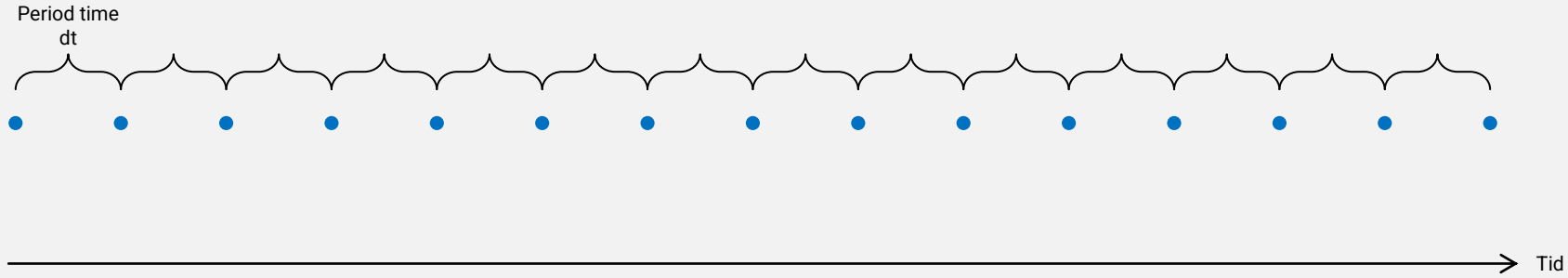
Periodic signals

A periodic signal is associated with two parameters which apply to the entire data set: Time for first sample (t_0) and the sample periode (dt).

Channels with the same t_0 and dt can be sampled and calculated together.



Aperiodic signals (events)

Each event has its own timestamp (t).

Examples could be a digital signal which changes level, an analog signal which crosses a limit, or a datagram received on network port.

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Datalogger software design

Principles and architecture

Datalogger software design – System Components

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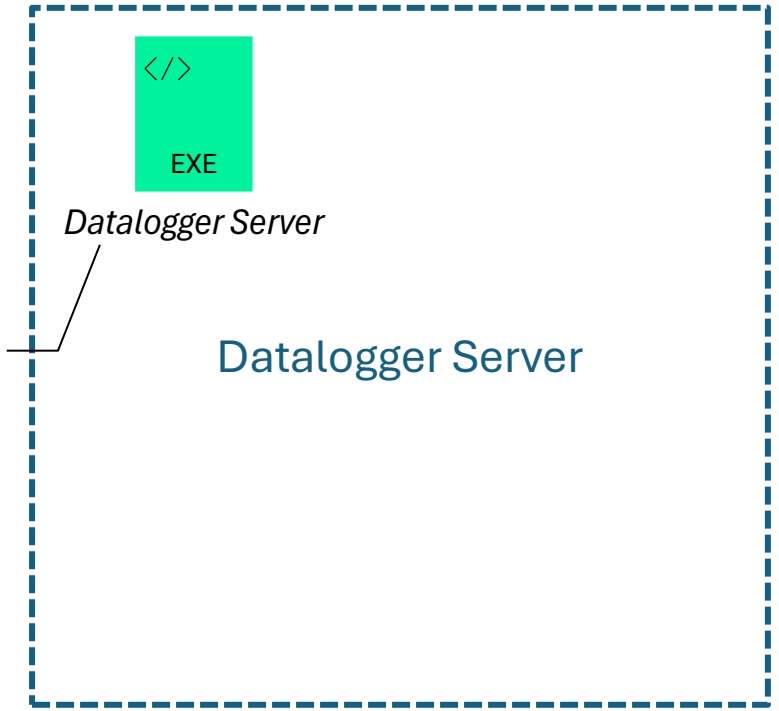
- Acquire, process and output data by use of plugins
- Automatic start of acquisition using valid config file.
- Can load plugins to extend capabilities.
- Can be controlled via its API.



Datalogger software design – System Components

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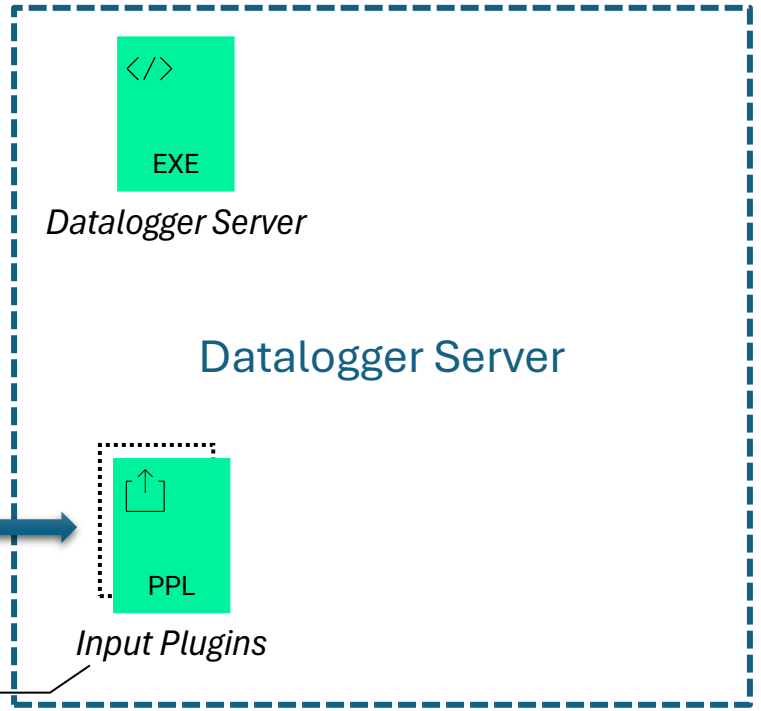
- Acquisition of data from physical channels.
- Can be periodic or aperiodic.
- Can continues or discrete.

Input devices



- Data acquisition from a specific input device type.
- Data conditioning by use of resampling.
- All channels can be delivered in multiple data rates if needed.
- Multiple instances of the same plugin type.

Datalogger software design – System Components

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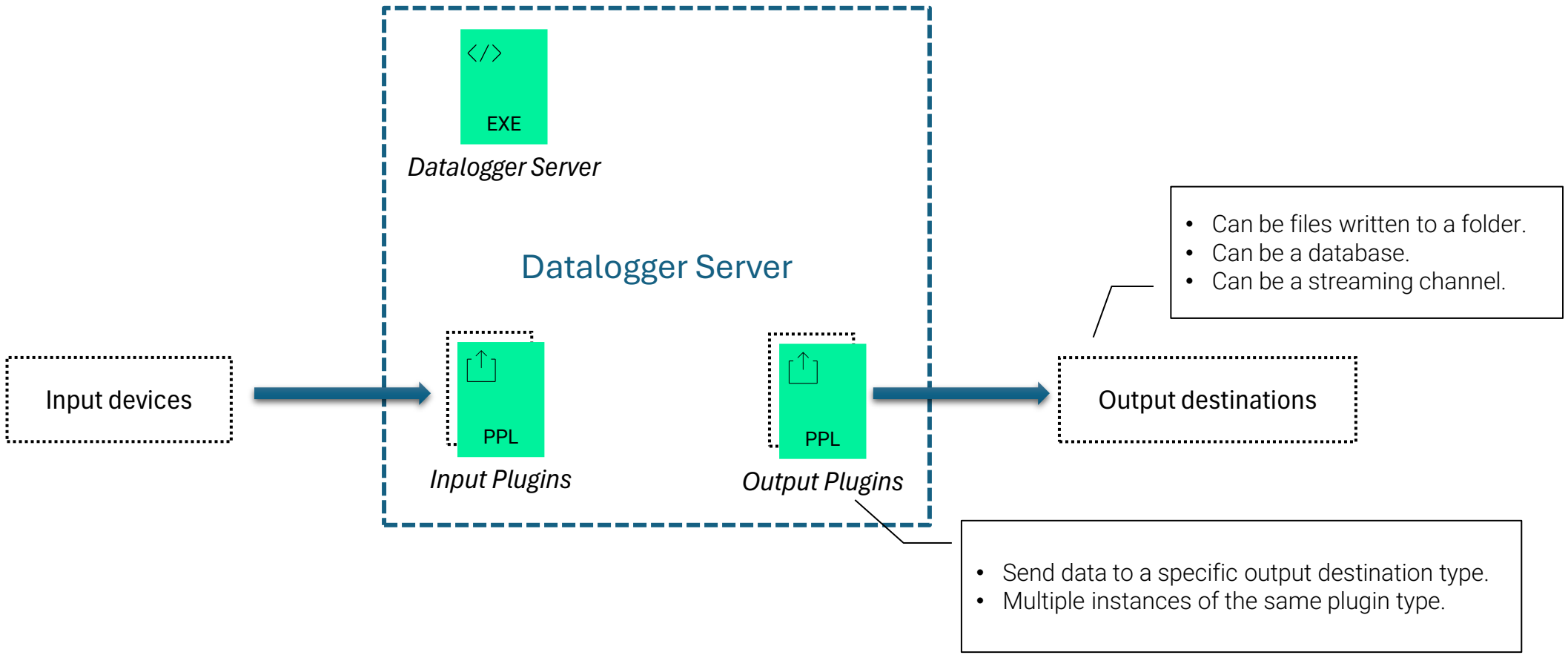

Datalogger software design – System Components

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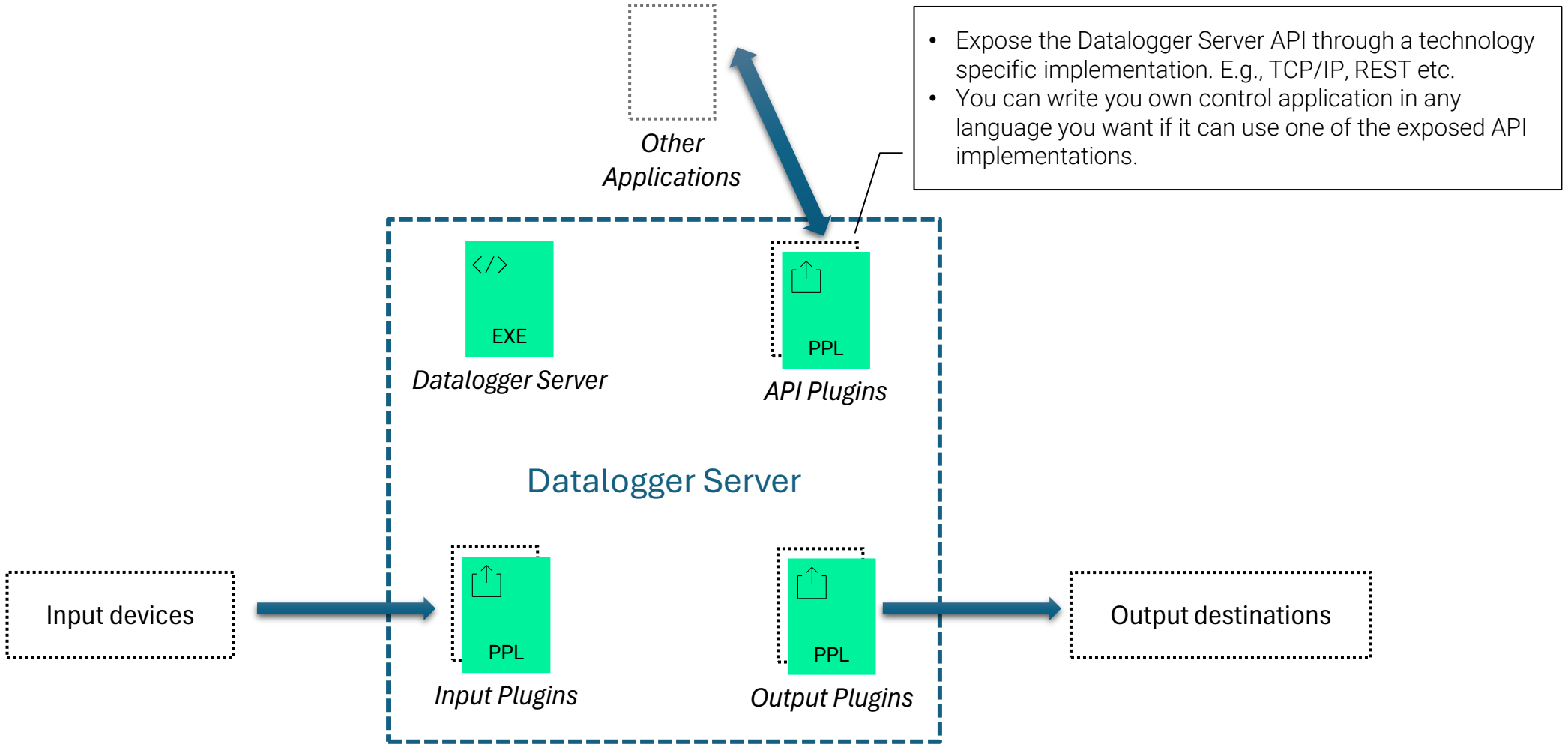

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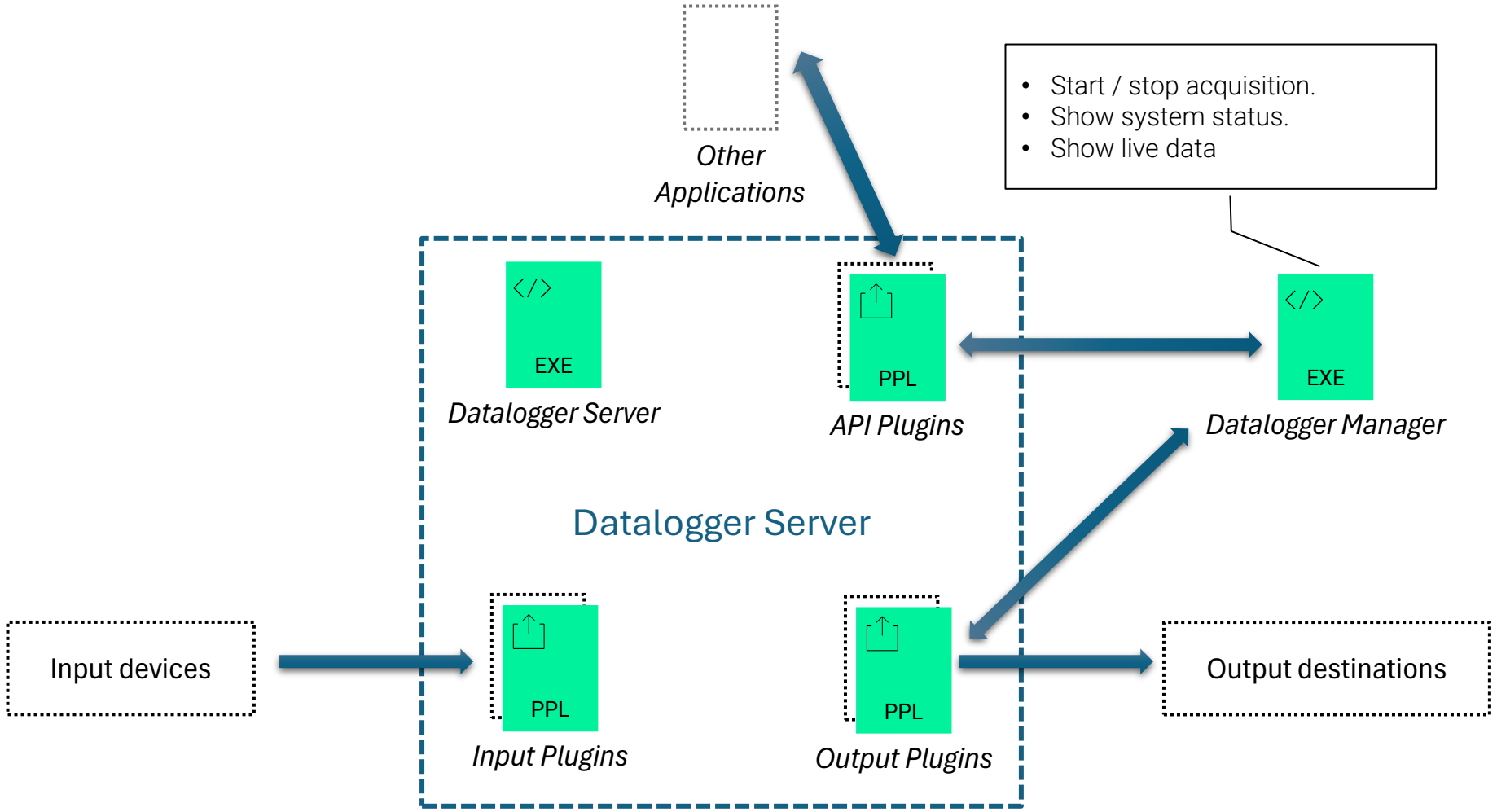

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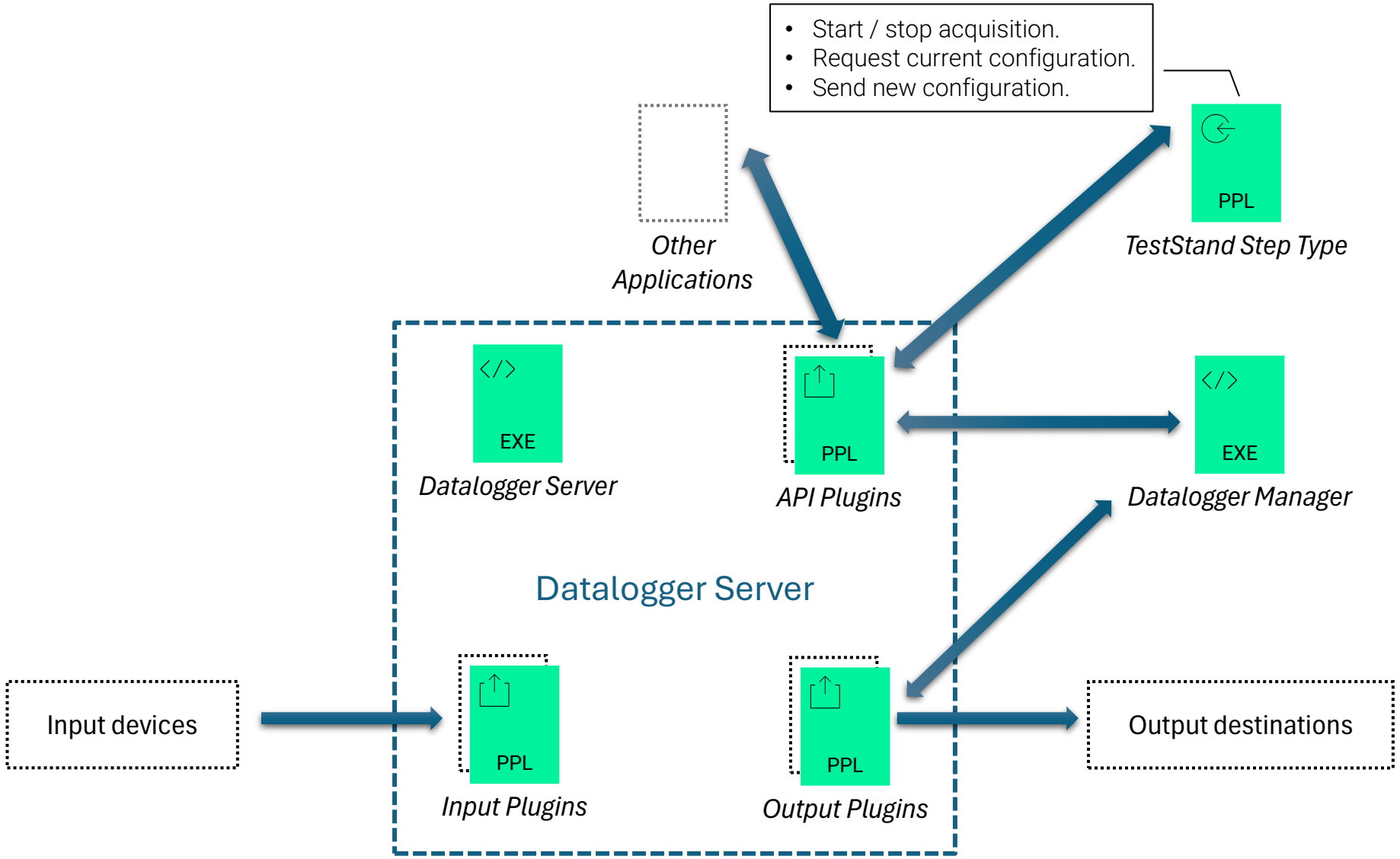

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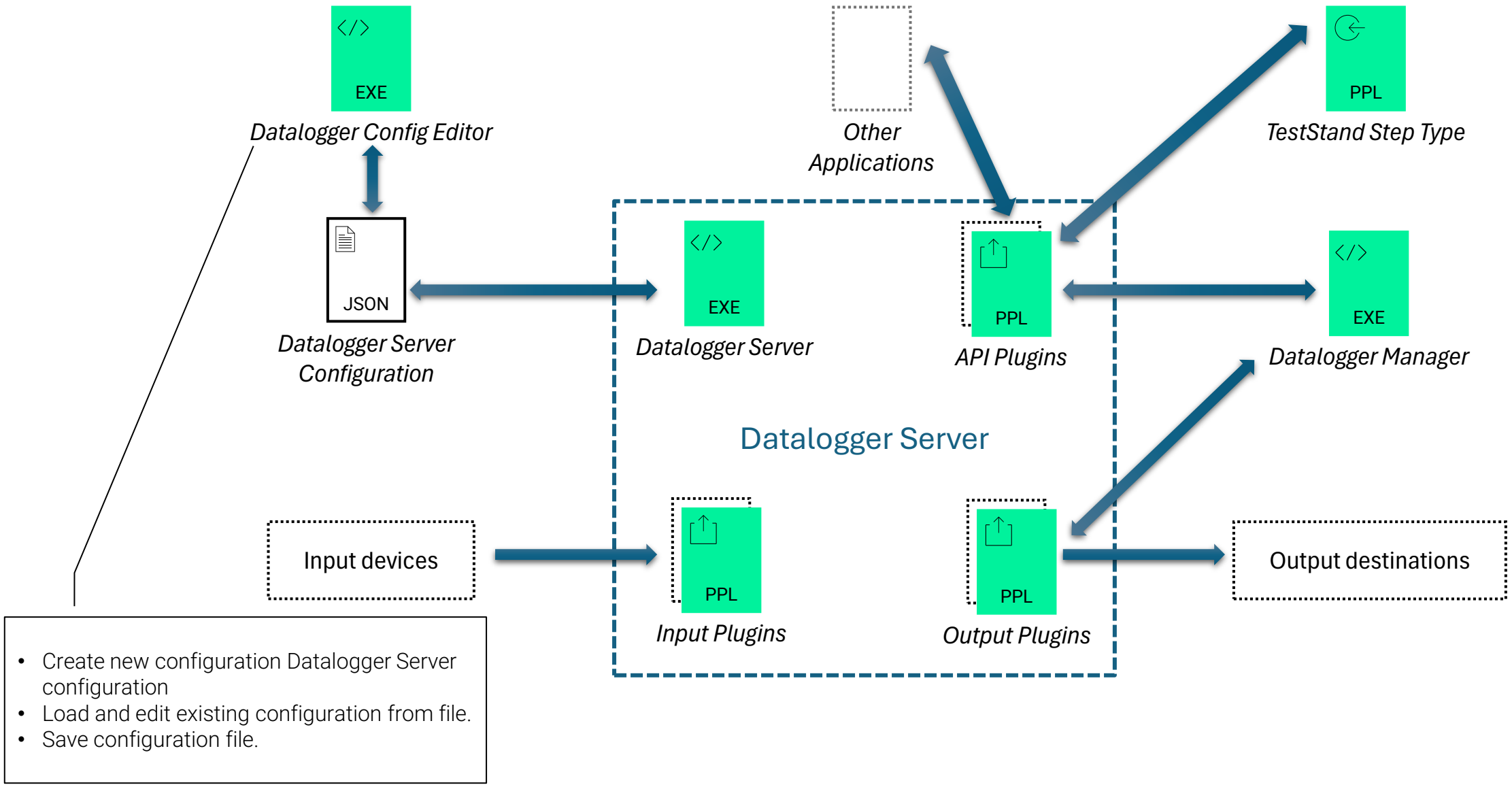

Datalogger software design – Dataflow

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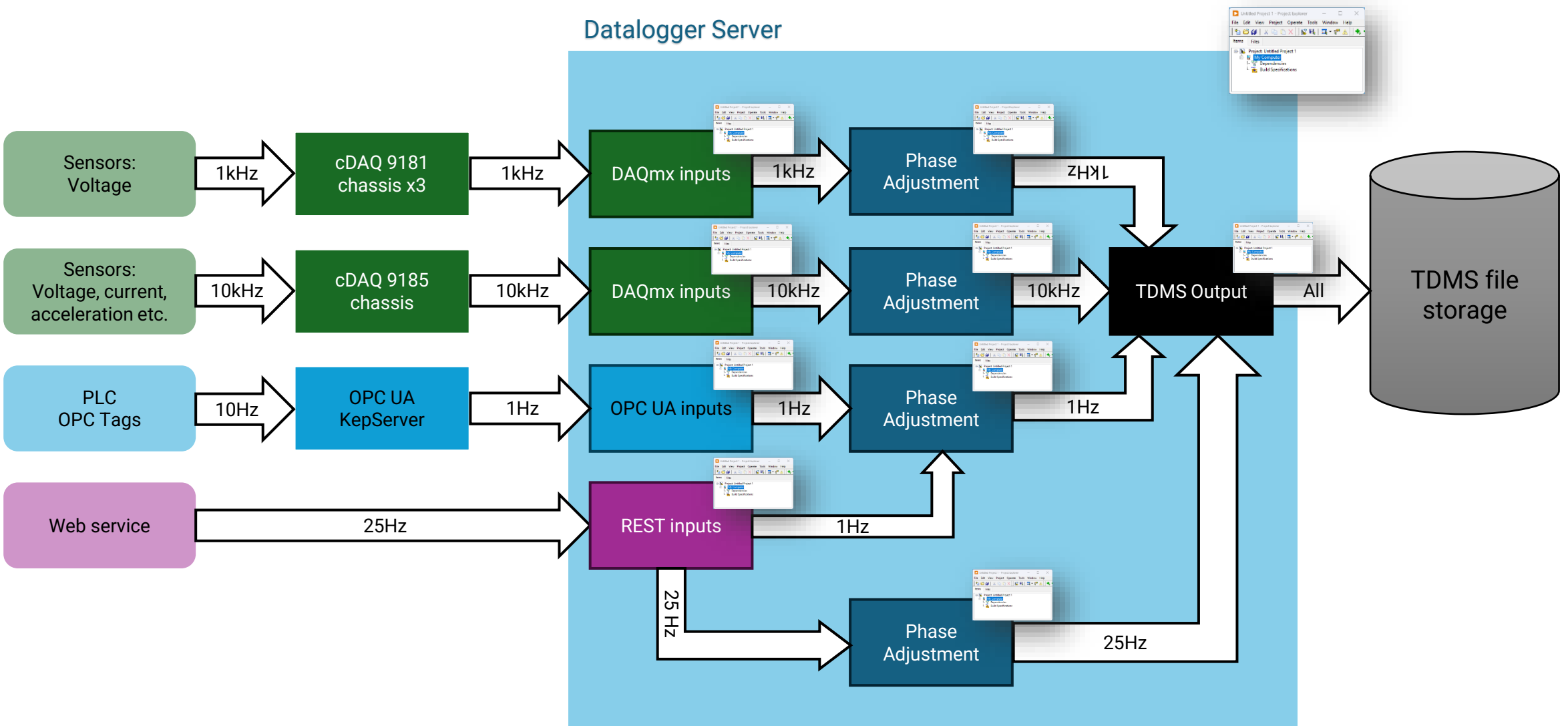

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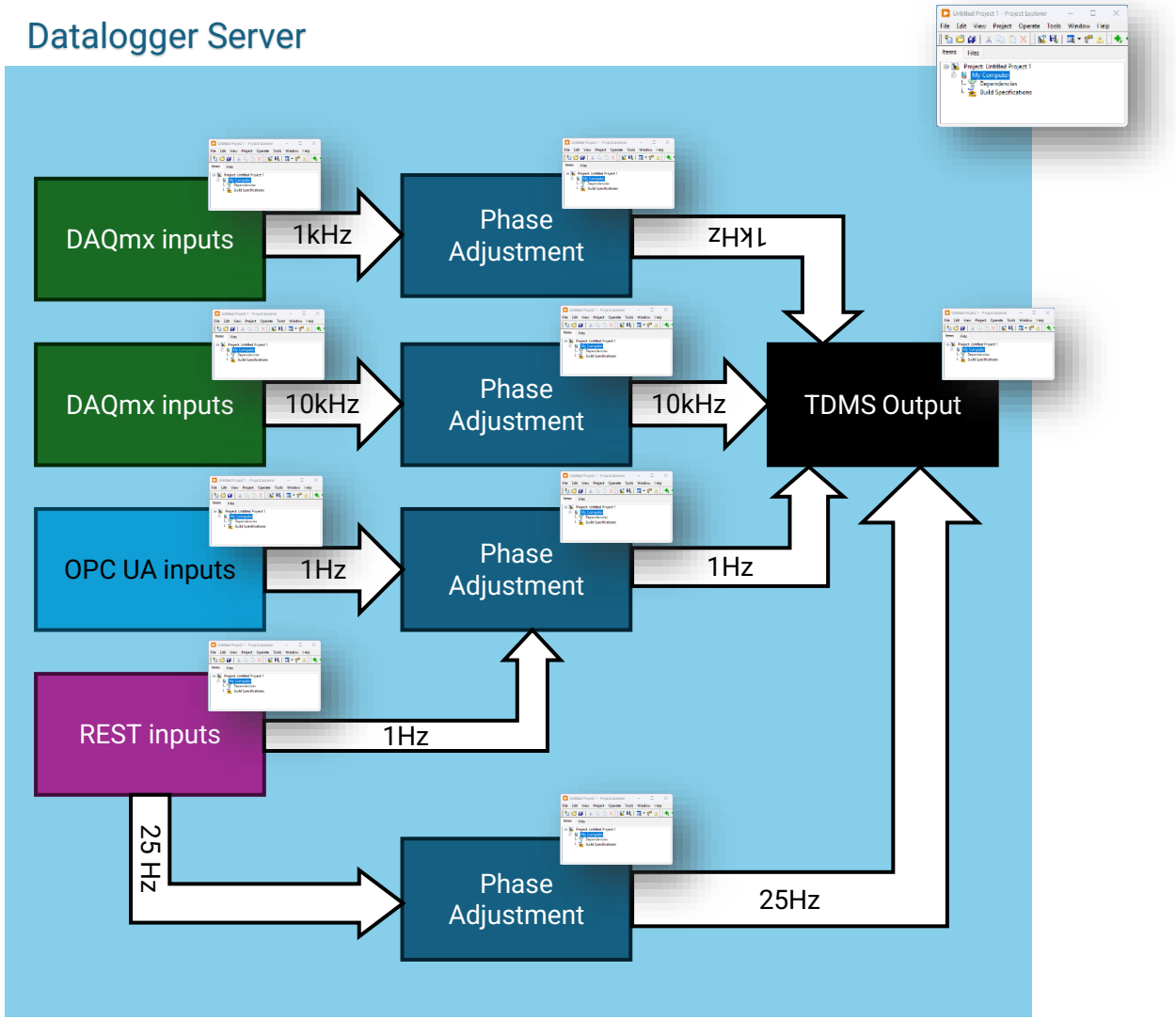

Datalogger software design – Plugins

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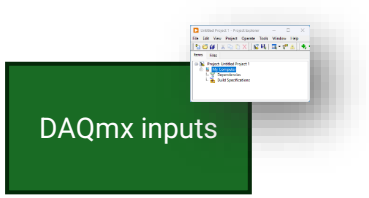

Datalogger software design – Plugins

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DAQmx inputs

NI 9220 Analog Input

Datalogger software design – Plugins

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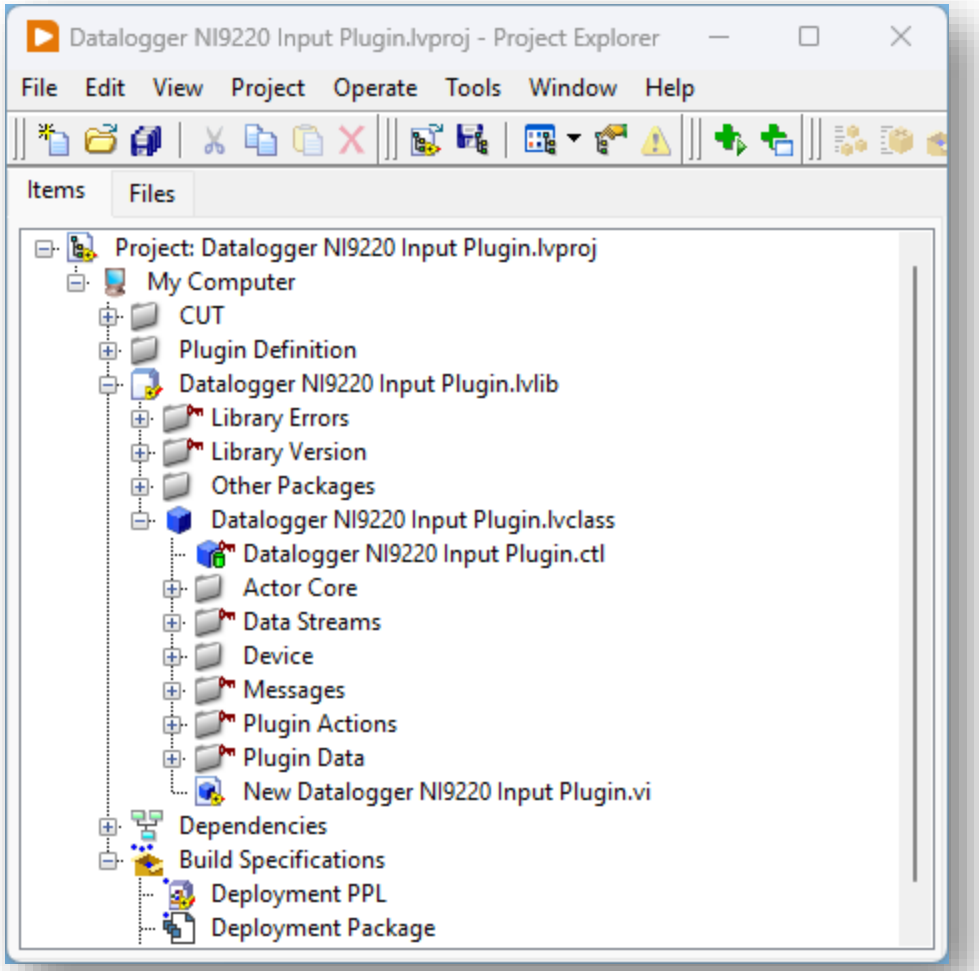

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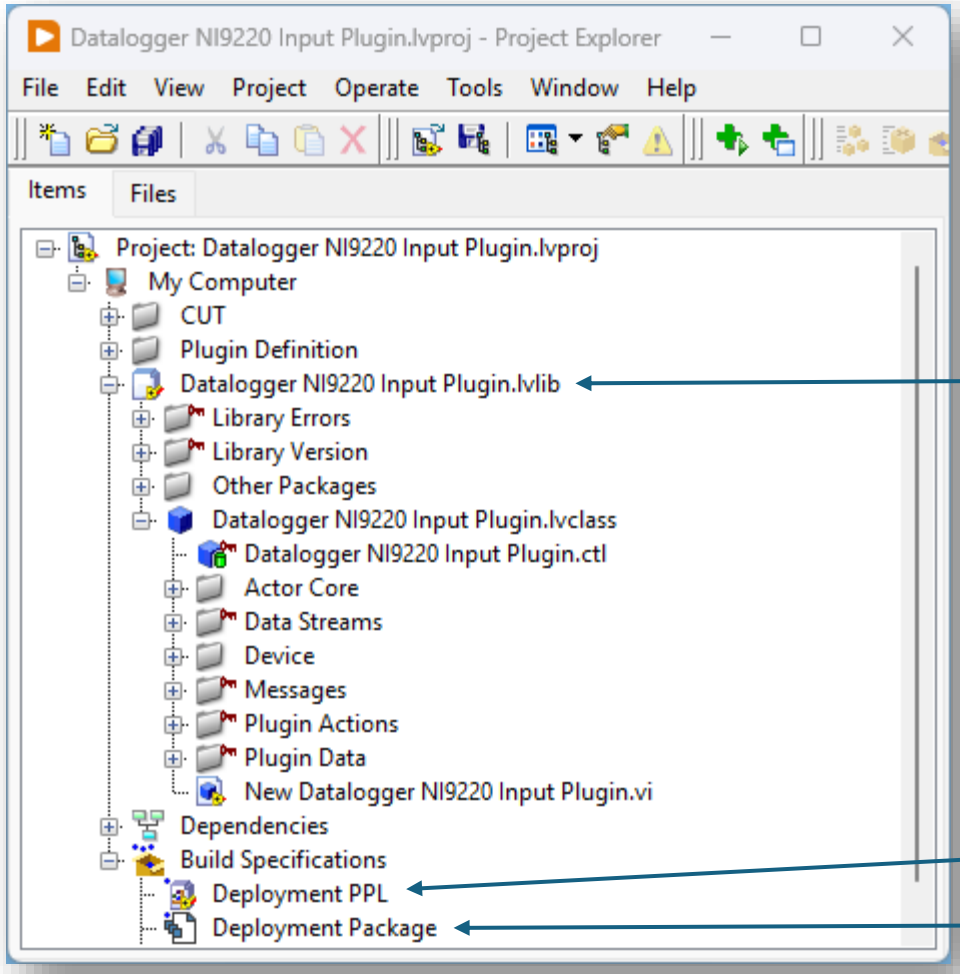

Plugin library

Plugin PPL

Plugin deployment packages

Datalogger software design – Plugins

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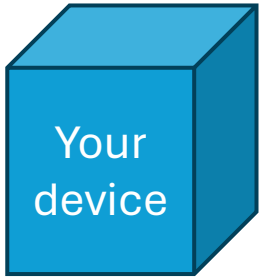

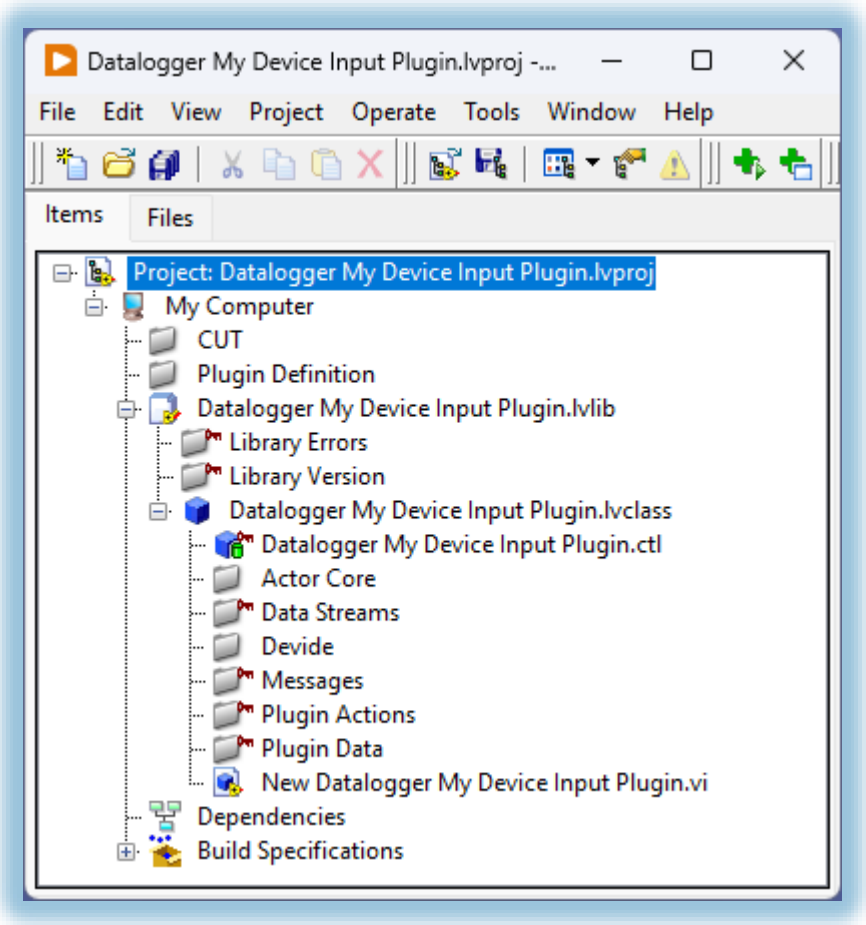

Create from template ➡ Build ➡ Deploy ➡ Configure ➡ Run ➡ Your data is in the system

Summery

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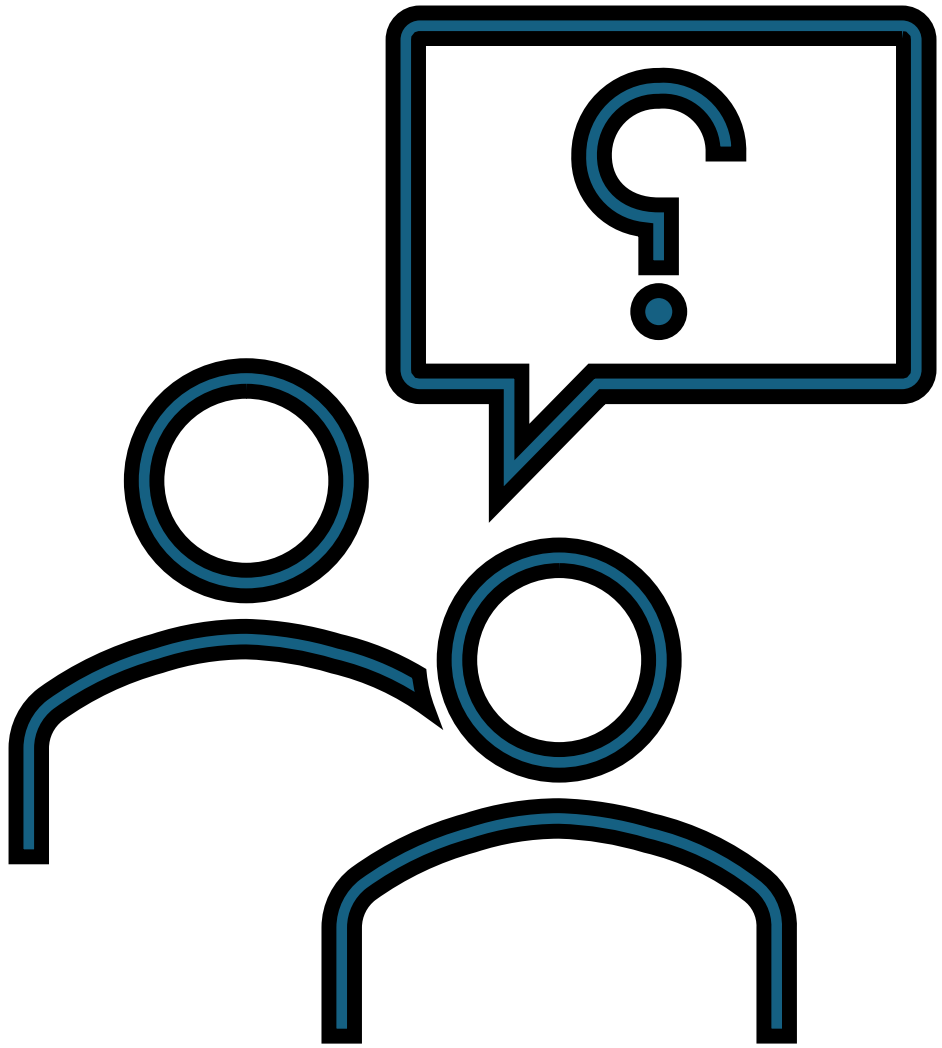
We built a datalogger system with data quality as our primary priority.

But also:

- It scales.
- It is open for extensions.
- It is accessible from NI TestStand



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Thank You!