Device Integration standards for EtherNet/IP

Paul Brooks, Rockwell Automation, Inc.
Wolfgang Hoeferlin, Endress+Hauser
Sean Vincent, FieldComm Group
Joakim Wiberg, ODVA, Inc.

Abstract

Following the acquisition of FDT technology by FieldComm Group (FCG), the industrial automation community has the opportunity to enhance our technologies to allow a single device integration standard to be used through discrete, hybrid and process automation disciplines. Double work on business logic and user interface for a device across different technologies and for use in different applications can be eliminated. In this paper we outline the use cases that FCG together with ODVA, PNO and OPC Foundation wish to address. We will look at some of the initial technical assumptions that allow this work to dovetail into device description improvements already underway within ODVA. We will discuss the framework that will allow ODVA members to contribute to, and benefit from this work.

Agenda

- The merger and high-level objectives for FieldComm Group
- FDI Primer
- FDT Primer
- FDI Gap Analysis for EtherNet/IP Applications
- Requirements for converged solution
- Long-term Vision

FDT-FDI Merger and Objectives

GOAL: One Entity Focused on Unifying Device Integration

FCG Slide modified

Process:

Vision:

Alignment of FDI and FDT technologies within a single organization enables support and development of a migration path and tools from the existing investment in FDI Device Packages and FDT DTM's to a single unified device integration solution.

This removes barriers that previously existed with two independent organizations and enables development of a unified solution and ultimately reduce supplier investment in multiple technologies.

The objective is to have an open forum for all SDO's to jointly cooperate on a single device integration solution for all protocols used throughout the industrial automation industry.

Alignment of Technologies Benefits

- Alignment of FDI and FDT technologies within a single organization enables support and development of a migration path and tools from the existing investment in FDI Device Packages and FDT DTM's to a single unified device integration solution.
  - Ensure support of current installed base of devices, hosts, and communication networks
  - Ensure that installed base of devices, hosts, and communication networks can better integrate to hosts for future harmonized technology
  - One device = one device package for all lifecycles of the plant

Single Organization Benefits

- This removes barriers that previously existed with two independent organizations and enables development of a unified solution and ultimately reduce supplier investment in multiple technologies.
  - Dedicated steering body for device integration strategy and implementation independent of any specific fieldbus
  - Ultimately converge to a single working group dedicated to the development of a unified integration solution by early 2025
  - Progressively reduces double investment in technology, tools, and certification

Benefits of Open Forum for All SDO's

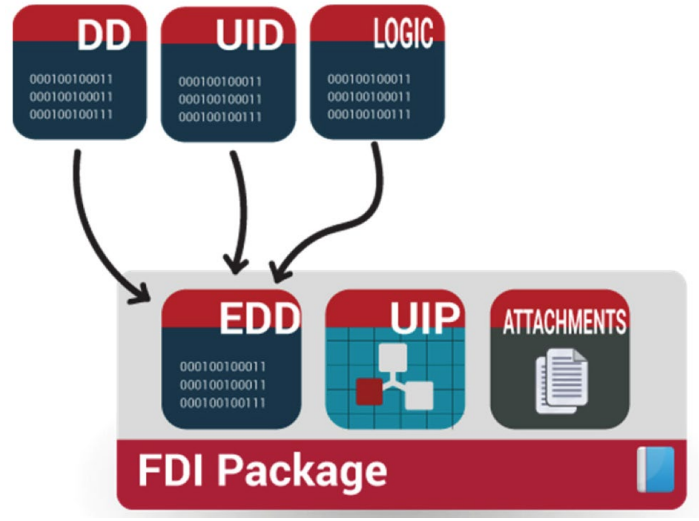
- The objective is to have an open forum for all SDO's to jointly cooperate on a single device integration solution for all protocols used in the automation industry.
  - Ensure protocol agnostic technology embraceable by all relevant field protocol organizations (FCG, PNO, ODVA, OPCF, etc.)
  - Technology will be cooperatively developed and shared with peer SDO stakeholders


30
YEARS!
2025
ODVA
Industry Conference and 23rd Annual Meeting

FDI Primer

FDI Device Package Background

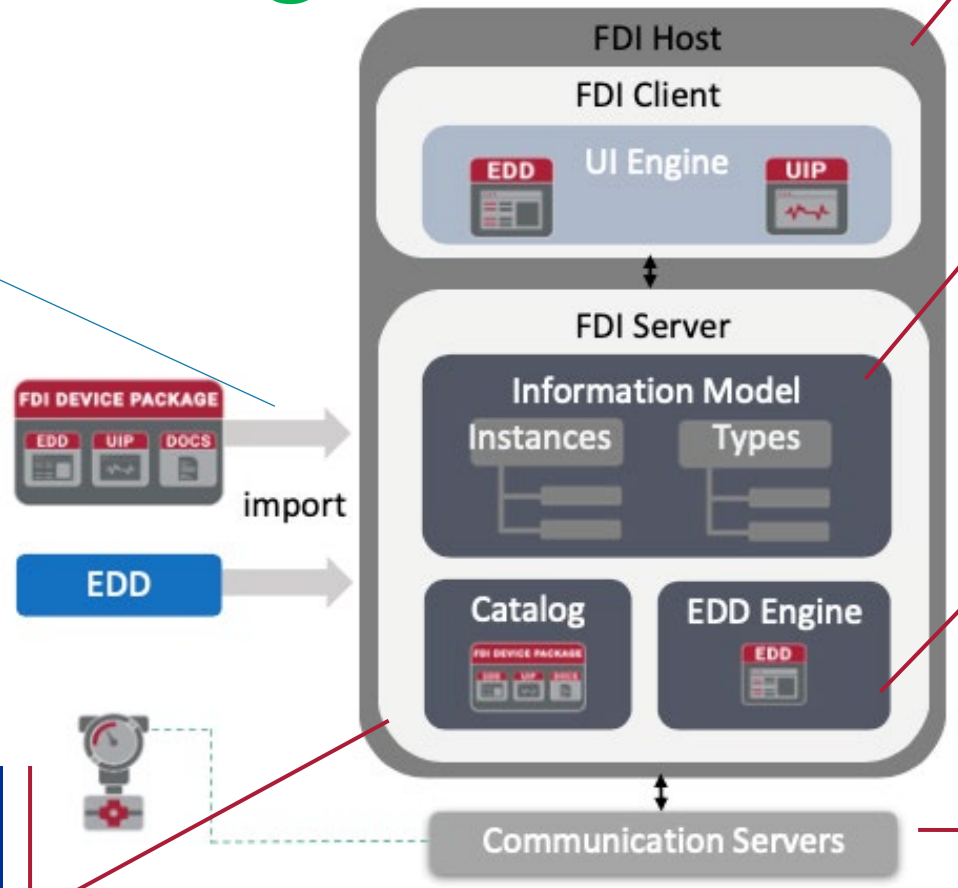
- An FDI Device package includes a mandatory EDD that is written to conform to the FDI Standard, it includes:
  - DD … Device description written in EDDL
  - UID ... Text based user interface description also written in EDDL.
  - Business LOGIC describing how the device operates (parameter dependencies, calculation algorithms, etc.) often referred to as METHODS written in EDDL.
- A catalog file is a key MANDATORY part of the FDI package. It contains basic information about the device.
- A UIP is optional, but if available must use HTML5
- Attachments are optional (PDF's, certificates, etc.)



FDI Host Background

FDI device packages are imported into the host catalog. No installer or .exe is used. All registered FDI device packages are available via a cloud interface API called FDI sync.

This product allows for hosts to continually access the latest registered package via an API.



The UI engine renders UID's from within the EDD or HTML5 UIPs within the framework of the host.

The optional FDI Info Model server manages the types of devices present in the system and the configuration of each instance of a device type. It is based on OPC UA specification OPC 10000-100

The EDD Engine interacts with the comm server and information model to maintain business logic integrity and database accuracy within the host. (DMS)

The FDI host catalog is the container that stores all of the imported FDI device packages.

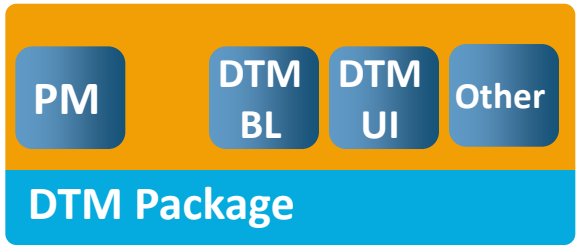
GPE
EtherNet/IP
Modbus, etc.

A comm server acts as the interface between an automation protocol and the FDI host. Comm servers are available for many protocols and can be created for more protocols.

FDT/DTM Primer

DTM Package

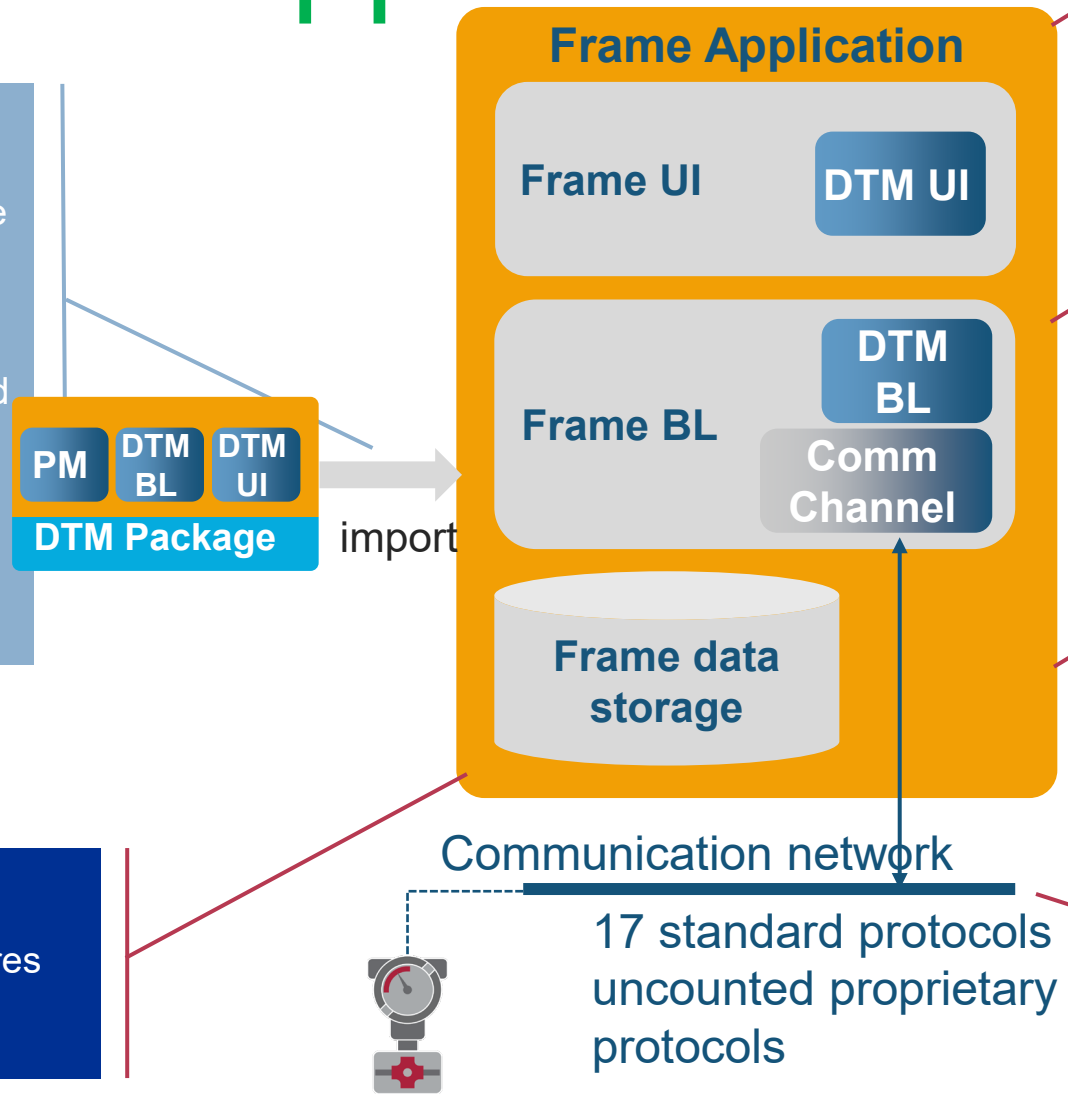
- A DTM package provides a device specific component, called Device Type Manager, according to FDT3 Standard.
  It includes
  - DTM Package manifest, description of the package
  - DTM Business logic, providing APIs and information about
    - Device identification (offline + online)
    - Device status (online)
    - Device parameters (offline + online)
    - Network configuration (including support files)
    - Device process values (I/O data)
    - Device related functions (UI and commands)
    - Documentation (of current device and references to other doc)
  - DTM User interface(s) in HTML5
- The package may include other files, e.g. additional binary elements, documents (e.g. DD files) and media related to the DTM or to the device



FDT Frame Application

DTM device packages are imported
into the Frame Applications device catalog. No installer or
.exe is used. All registered DTM device
packages are available via a cloud interface API called FDI sync.

This product allows for Frames to continually access the latest registered package via an API.



The Frame Application may run with or without UI (headless).
The Frame Applications UI (.Net or HTML5) hosts the DTM UI and enables the data exchange with the DTM BL.

The Frame Application manages the project, i.e. the number of devices and the project structure.
The Frame may expose an OPC UA interface providing online and offline data from the DTMs based on OPC 10000-100 (like FDT Demo Server).

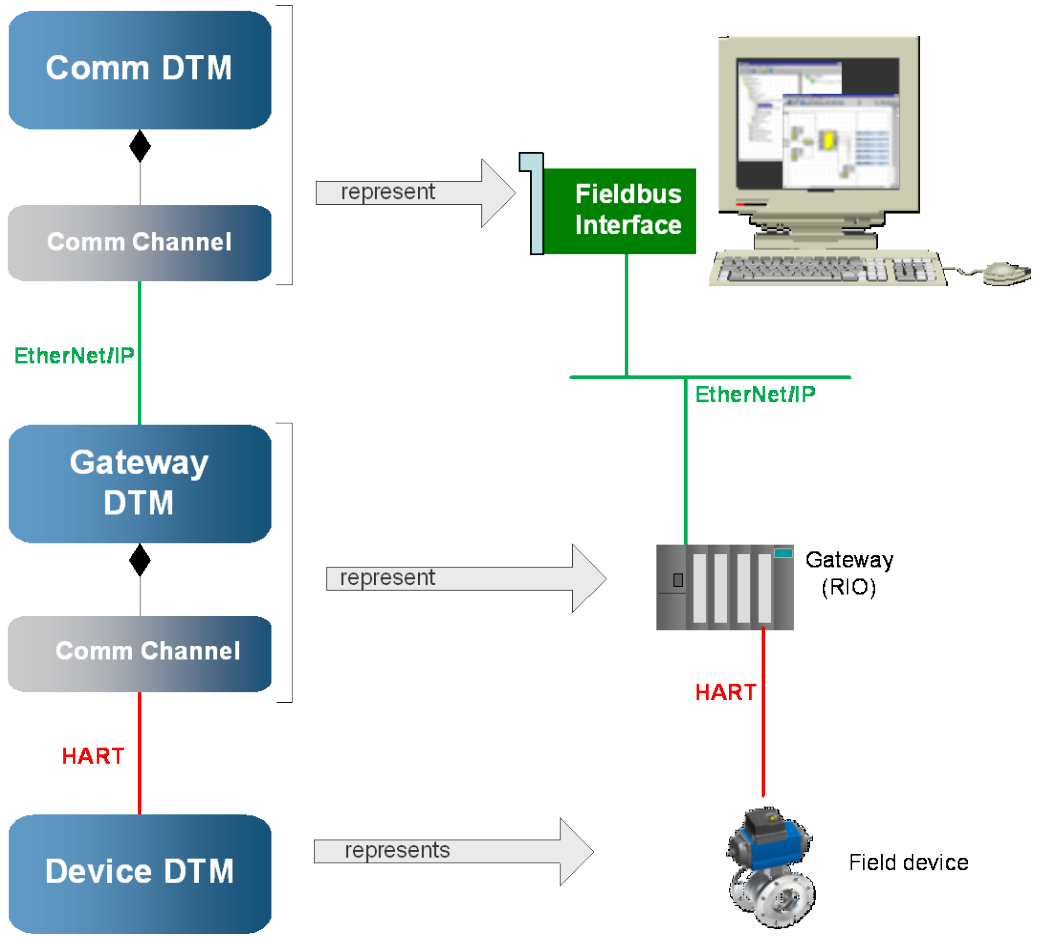
DTMs interact with the respective device via Communication Channels.
Comm Channels may be provided by Comm DTMs, Gateway DTMs or the Frame Application.
The DTM stores its data into the storage managed by the Frame Application.

The Frame Applications device catalog is the container that stores all the imported DTM packages.

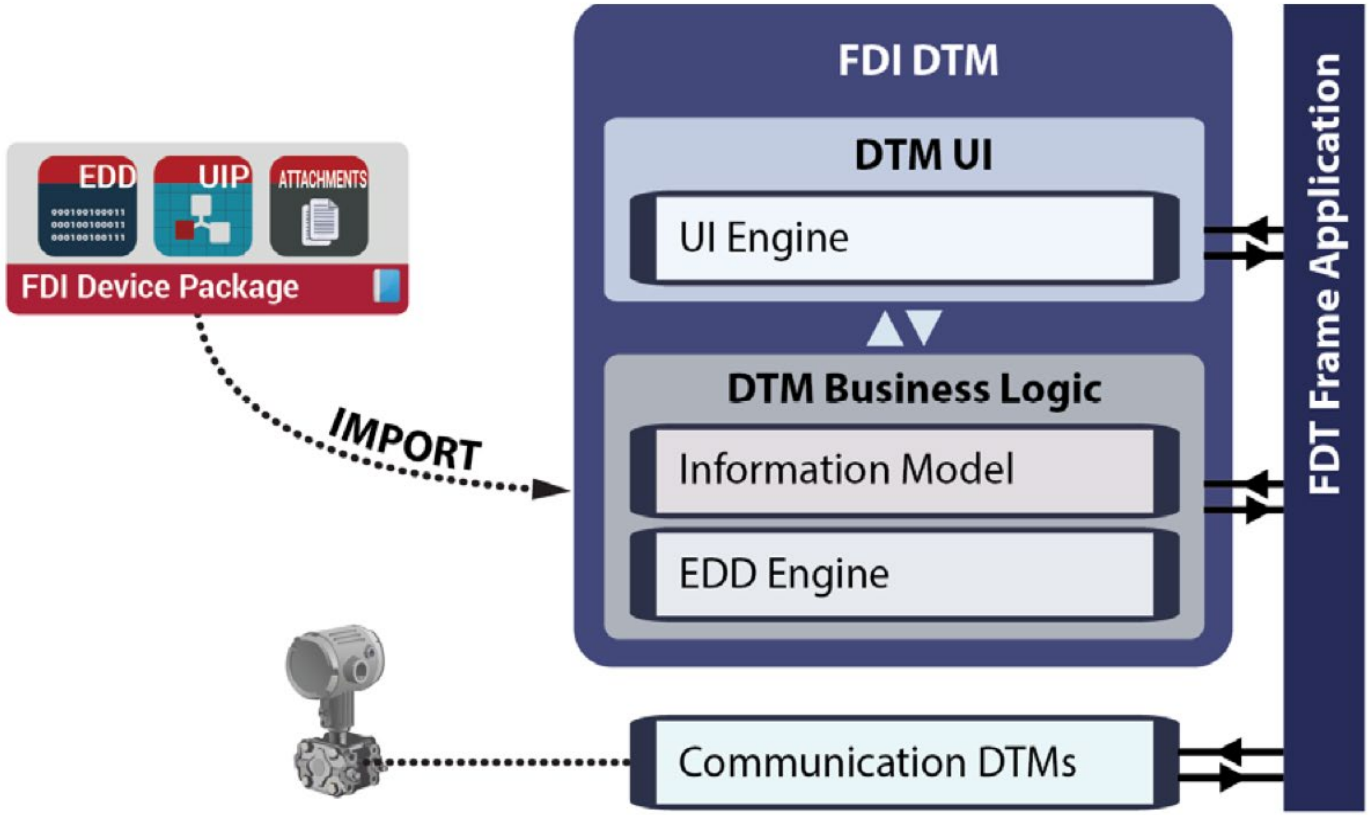
FDT defines support for a large number of standard communication protocols.
The support includes access from the DTMs to devices as well as support for setting up communication and for configuration of transport for I/O values.

Nested communication

- Concept to simplify communication access for Device DTMs (DTM sees only one level)
- Communication structure is reflected by hierarchy of DTMs
- Comm DTMs provide access to communication
- Gateway DTMs represent gateway devices, i.e. a Gateway DTM uses communication and provides access to communication
- Device DTMs uses communication



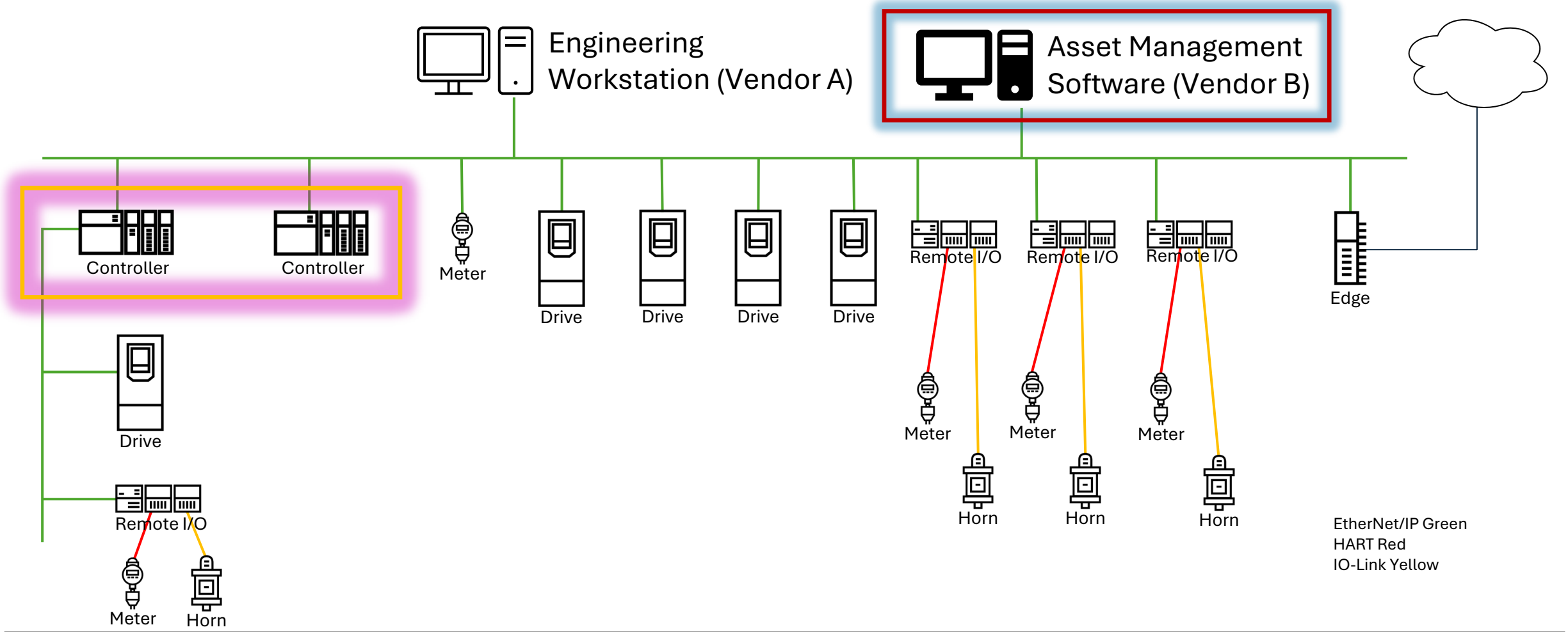
FDI in an FDT/DTM Environment



FDI Gap Analysis

Typical System Architecture

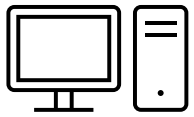
FDT only used for Asset Management Software Use Case



Configuration Workflow

80% of applications – other workflows apply in other 20%

View in present mode



Engineering Workstation

Source of all system configuration
Tells controllers how to talk to I/O & devices and I/O how to talk to devices

Disappears after download to the Controller

CONTROLLER

Controller

One controller supports multiple isolated network segments, I/O modules and other EtherNet/IP devices

All configuration for devices under this controller can be uploaded in runtime

REMOTE I/O

I/O

Has not yet been installed at time of controller download
A modular I/O system can have modules managed by different controllers

Both a device and a gateway

HORN

Device

Devices may be direct EtherNet/IP, IO-Link or HART.
EWS manages them all in a consistent manner

Devices take configuration from a single source, tuning from anywhere

Asset Management

AMS late retrofit and unaware of relationship between controller and device
AMS user not concerned with communication path or route
Communication ‘direct to device’
RO for configuration information, RW for tuning

Integration Technology Options

Snapshot of today, not our future ambitions

- FDT
  - Through Interpreter DTM, can present interface to any Device – EtherNet/IP, HART & IO-Link
  - Interpreter DTM uses same source asset as EWS (EDS, IODD or EDD)
  - Comm DTMs provide connectivity to backbone Ethernet, Machine local Ethernet, HART I/O and IO-Link I/O
  - Vendors can provide DTMs for our own infrastructure
  - Without windows dependence, ability to program Business Logic in C, Python, C# etc. would be a significant benefit
- FDI
  - Nested communications not available
  - Ability to support multi-vendor I/O at gift of AMS supplier
  - Dependency on EDD makes AMS support a bigger burden than FDT
  - EDD is lossy translation of EDS
  - FDI limited help with 80% workflow because it is unaware of I/O or controller needs
  - UIP & Business Logic represent double work for us (unless implemented through FDT iDTM)
  - No separation data, BL & UI
- Common
  - We assume
    - Homogeneous EWS/controller supply
    - Heterogeneous Device (EIP, HART and IO-Link), I/O, OWS and AMS supply
    - EWS uses single approach independent of selected AMS

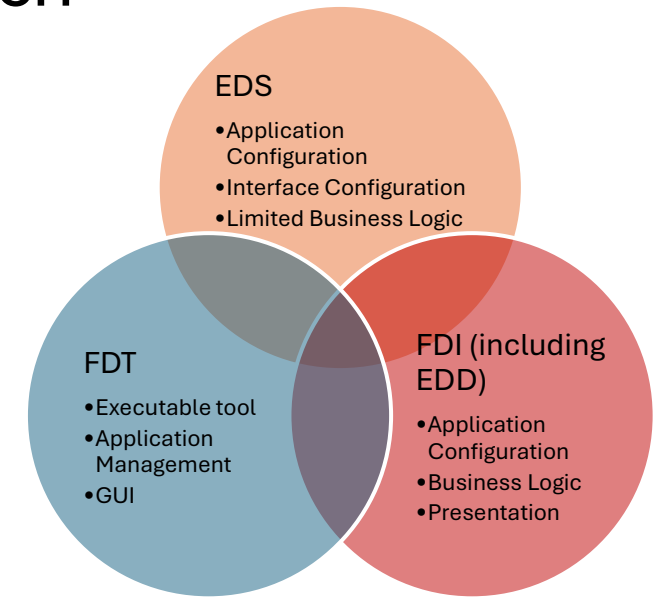
Asset Management Software Focus

Requirements for Converged Solution

ODVA Perspective

Problem Statements for Integration

- Existing technologies developed for different use cases & industries
  - Today no asset type supports all
- User seeks speed and simplicity, optimized for each use case
  - In all stages of the system lifecycle
- Devices are unchanged in all use cases and tools
- Device and tool lifecycle shortens
  - Unready for DevSecOps & IEC62443
- IT/OT Integration is introducing new paradigms
  - And demands new technologies
  - Focus moves from Communication -> Information Model



Vendor Goal

- A device can be brought to market with multiple communications interfaces and applied in all market segments connected to any host* with single device integration interface (presentation and business logic). A host engineering tool can integrate and manage a device independent of its underlying communications protocol*
- Technology SDOs ensure (through conformance test) that devices and hosts are interoperable for both communication **and** integration

* This does not assume that all hosts support all protocols, or that all protocols deliver identical outcomes. Just that what is common is done once.

Defining Success

- We will know the FieldComm SIC is successful if seamless device and system commissioning can be archived ensuring cyber security requirements, providing full life-cycle management and decommissioning in a fully converged network, still maintaining the highest level of ease-of use.
- The automation industry will benefit from the work of the FieldComm group SIC because the increased skill gap and lack of competence will require our ever increasingly complex systems to be easier to use. The collaboration lowers the bar with the potentiality of harmonization.
- ONE association managing and driving harmonized Integration Technologies as base for new upcoming industry applications (tools, services, 2nd path access, AAS)
- All of the leading controller companies support the new integration technology in their engineering tools

Long Term Vision

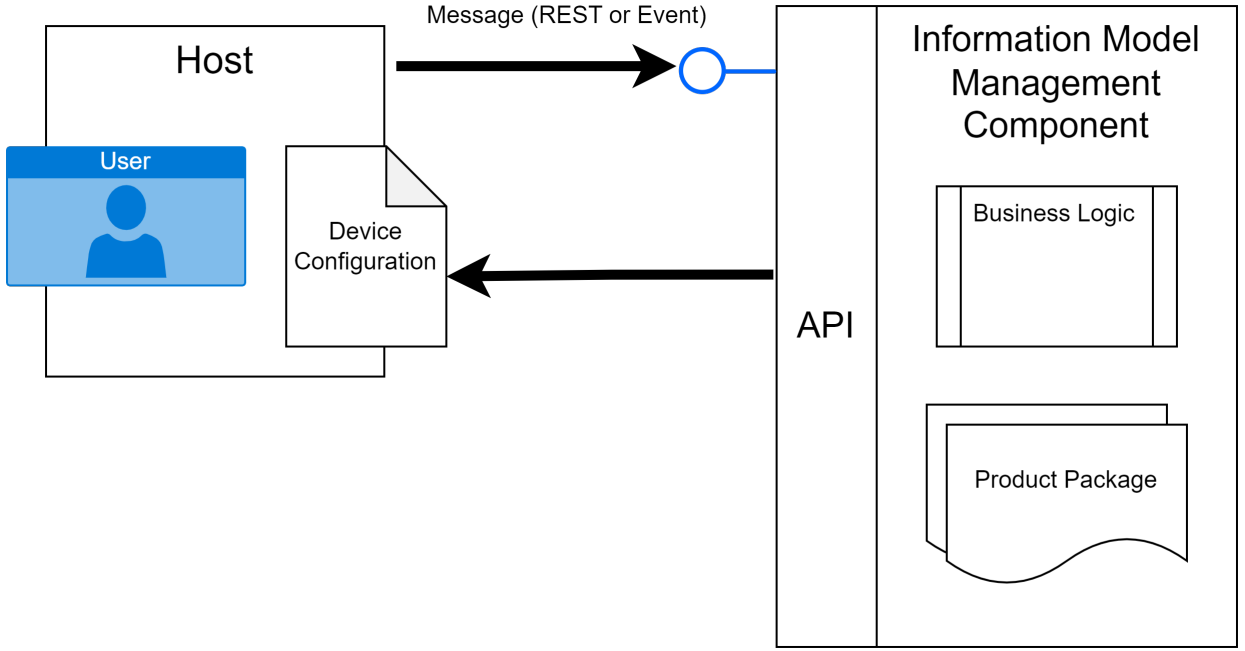
Longer Term - Can we agree on the following?...

- FDI+ package - One Package for FA and PA with support for:
  1. Data only devices - only data (parameters)
  2. Data + B/L devices
  3. Data + B/L + user interface devices
  4. Data + B/L + user interface + dynamic devices – eg. Modular I/O, Multivariable Device
- Expedite definition of FDI+ device package to inform DTM developers on a migration path
- FDI+ will support nested communication
- Host will be required to provide a minimum level of support for FDI+ packages. This will include presentation of devices that don't provide their own user interface.
- FCG to provide host common components to enable FDI+ packages.
  1. Requirements need to be discussed further
  2. Will provide a tool for migration of FDT and FDI to FDI+
  3. Use of the common components will enable implementation and conformance
- Conformance is required for the host and FDI+ devices
- FDI+ needs to be adopted by the SDO's
- Develop a migration matrix (path) for FDI and FDT

API First Concepts

Well defined API provide functional services which are integrated by the host application

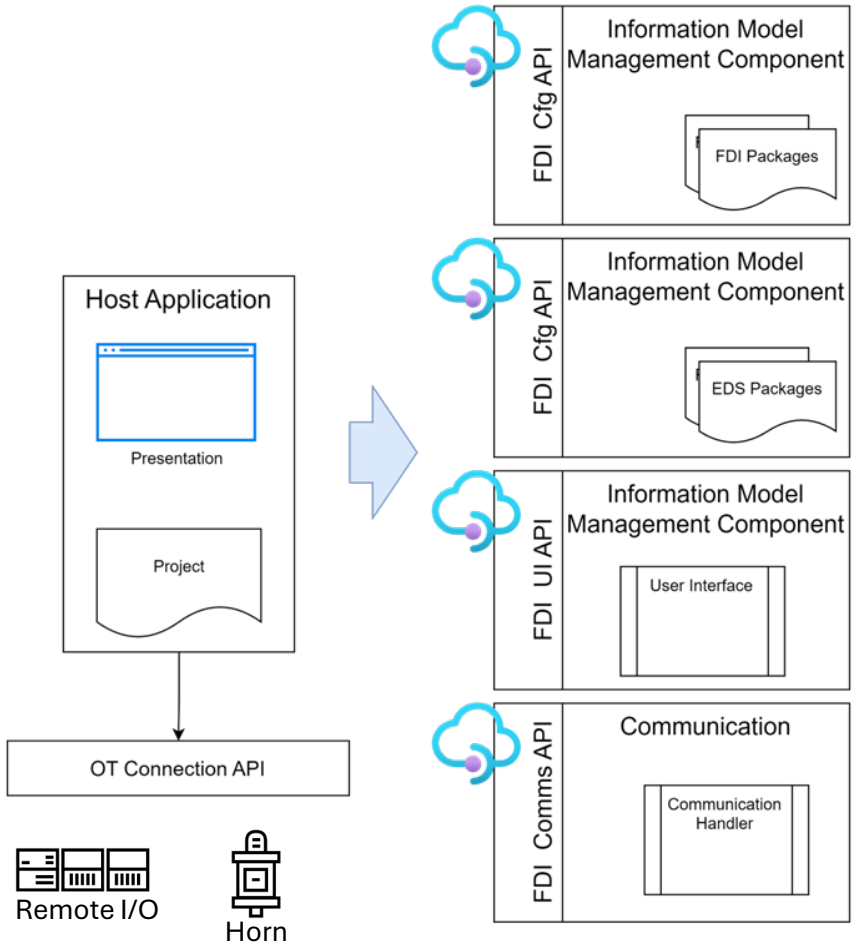
Host could be
- A webpage
- Mobile App
- Desktop App
- Compiler



The IMM Component is independent, and self contained
- Container
- Executable
- Website
- Serverless Functions
- WebAssembly

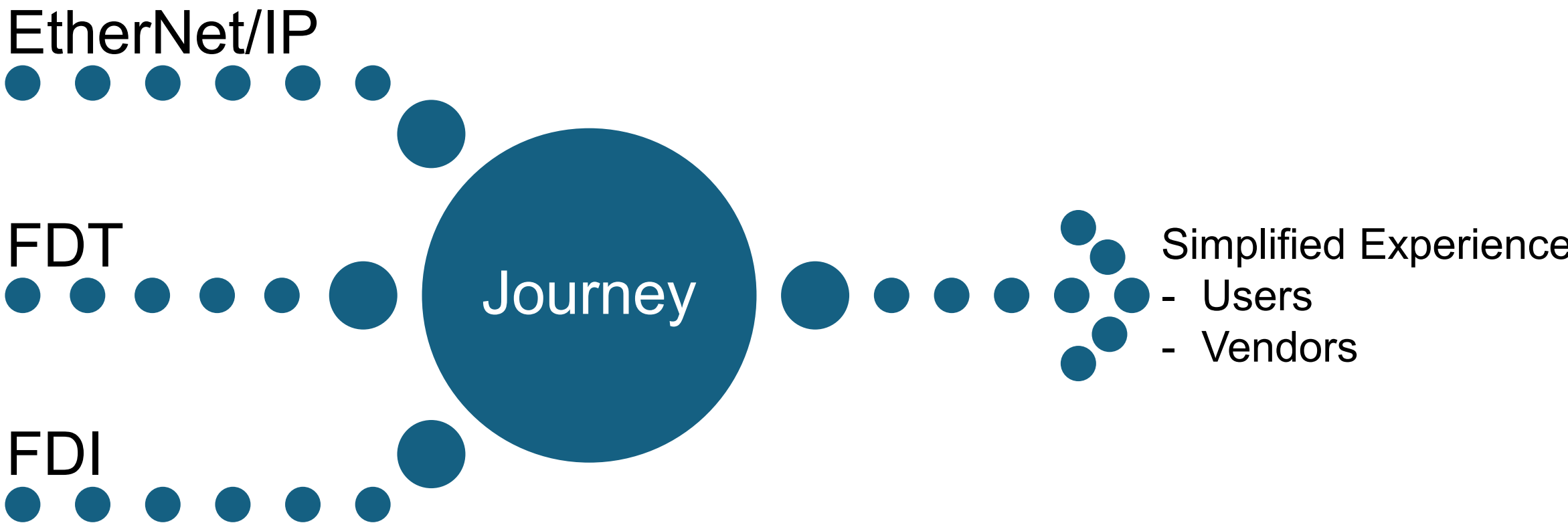
API First in context

The solution is not a monolithic application but a collection of services implementing the same API



- Stateless
  - Instances of a devices aren't saved
  - Same input produces the same output
  - Enables scalability
- Zero trust
  - Credentials required at all interfaces
- Platform independent
  - Different services may be used per platform however the API remains the same
- No direct connection to the OT network
- Deployment
  - Multiple options/technologies/platforms
  - Versionable

Questions




30
YEARS!
2025
ODVA
Industry Conference and 23rd Annual Meeting