



# Integrating IO-Link Devices into CIP Networks

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**Technical Track**

[www.odva.org](http://www.odva.org)

- ▶ Introduction
- ▶ CIP Integration Objectives
- ▶ CIP IO-Link Master Models
  - Virtual CIP router
  - Mixed
  - Scanner
- ▶ CIP IO-Link Definition
  - New/Changed objects
  - Identity Object
  - Keying
  - Parameter addressing
  - Data Types conversion
  - IODD to EDS conversion
  - Others

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# IO-Link Introduction

- ▶ IO-Link is an extension of the 24 VDC interface
  - Roughly analogous to HART over 4-20mA interface
- ▶ Point-to-point physical connection between IO-Link Master and IO-Link Target device
- ▶ Real-time data and parameter data
- ▶ Device configuration support in IO-Link

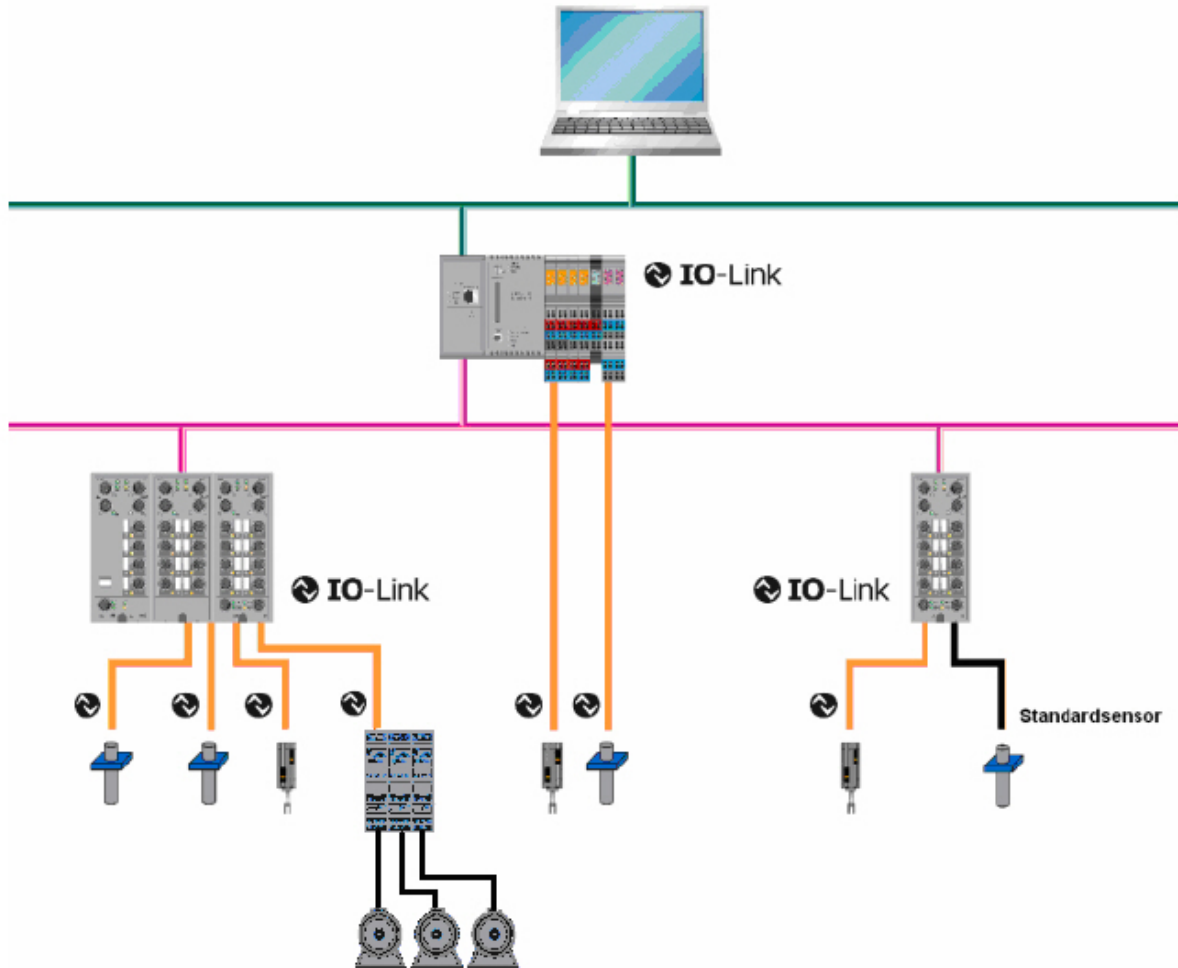
# IO-Link Introduction

**Microcontroller-based intelligent small sensors and actuators (devices) have a lot of built-in parameters, however the IO-Link protocol is different than CIP.**

**Users are asking for CIP access to:**

- ▶ Parameter monitoring and expanded diagnostics
- ▶ Setting configuration parameters
- ▶ Automatic device replacement
- ▶ Real time I/O data

# IO-Link Technology Domain



# Why IO-Link?

## Target use cases

- ▶ Replacement of analog 4..20mA interfaces
- ▶ Parameterization of small devices (sensors and actuators)
- ▶ Getting detailed diagnostic data
- ▶ Monitoring of device conditions
- ▶ Low cost "dumb" sensor concentration - an IO-Link "hub" costs less than an equivalent fieldbus device

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# Key Objectives

- ▶ The IO-Link Master device shall support IO-Link process data and parameter access
- ▶ CIP I/O communications RPI times shall meet or be faster than IO-Link process data exchange times
- ▶ IO-Link integration shall be defined for most CIP networks (excludes CompoNet)
- ▶ Support for IO-Link types conversion to/from CIP types for both process and parameter data

# Easy Integration

- ▶ IO-Link Target devices should appear as much like CIP devices as possible
- ▶ The IO-Link Master device standard should have no restrictions and be open to any vendor or supplier
- ▶ IO-Link Master and Target device replacement should only require the typical steps for CIP device replacement
  - CIP originator holds the configuration for the master and target devices

- ▶ 9/2012 – Project plan (completed)
- ▶ 1/2013 – Requirements (completed)
- ▶ 1/2014 – Specification (in progress)
- ▶ 12/2014 – Publication and Conformance Test Plan (not started)

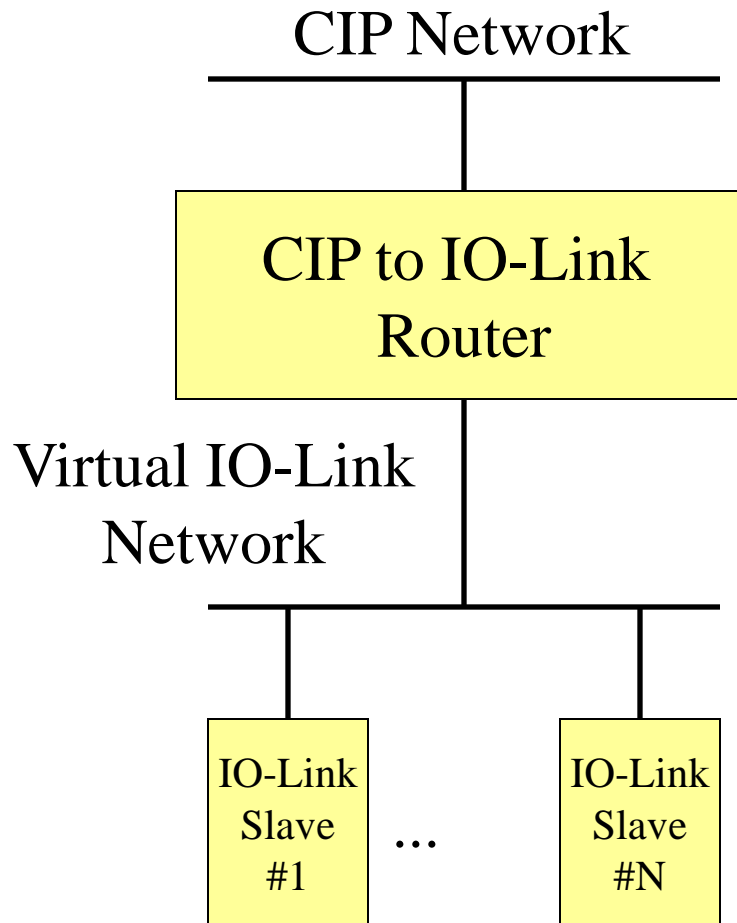
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# IO-Link Master Models

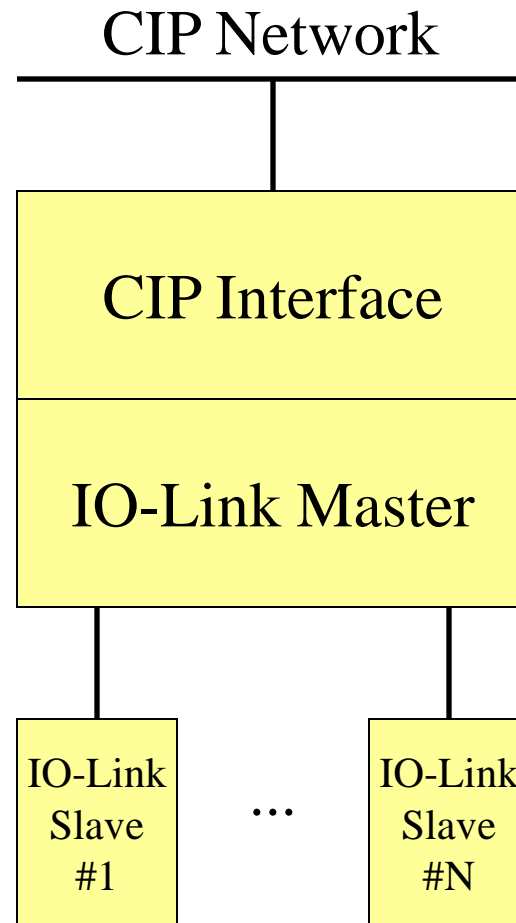
- ▶ Virtual CIP Router – IO-Link Master device provides IO-Link Target I/O and parameter access (explicit messaging) via a port segment (IO-Link Master models IO-Link as a CIP subnet)
- ▶ Mixed - IO-Link Master device accumulates I/O to/from IO-Link Target devices and provides parameter access via a port segment
- ▶ Scanner – IO-Link Master device accumulates I/O to/from IO-Link Target devices and provides an object for accessing IO-Link Target device parameters. The SIG is working to determine if this model needs to be defined

NOTE: The Virtual CIP Router and Mixed models present IO-Link Target devices as if they are on a CIP bus

# Virtual CIP Router Model



# Scanner Model



# Justification for multiple models

- ▶ Virtual CIP router model – preferred, IO-Link Target devices look like CIP devices
- ▶ Mixed model - some systems can't support or can't afford a connection for each IO-Link Target device
  - For a network like DeviceNet existing implementations are limited to the predefined master/slave connection set which limits the number of connections
  - For other networks opening one connection per IO-Link target consumes too many resources
- ▶ Scanner model – some originators systems don't support configuration of routed communications



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# New/Changed objects

## ▶ New objects

- IO-Link Device Parameter Object
- IO-Link Link Object (Virtual CIP router and Mixed models)
- IO-Link Master Object (Mixed and Scanner models)

## ▶ Changed objects

- Identity Object
- Port Object

# Identity Object and Keying

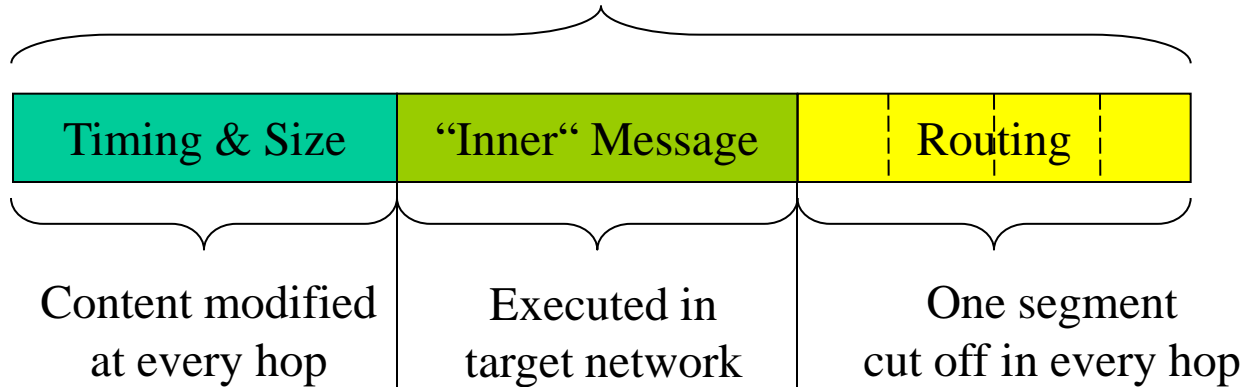
- ▶ New attribute(s) defined to provide IO-Link Target device identity
- ▶ New information defined in Get\_Attributes\_All response data to indicate device supports additional identity information
  - New Get\_Additional\_Attributes service defined that returns additional identity attributes, including IO-Link Target device identity attribute(s)
- ▶ New electronic key segment type defined to key IO-Link identity

# Parameter addressing

- ▶ An IO-Link Device Parameter Object will be defined to support IO-Link Parameter access
- ▶ IO-Link Parameters are addressed by Index and Sub-Index
- ▶ For CIP Explicit Message requests (connected or unconnected), Index will be provided as the Instance and Sub-index will be provided as the Attribute
- ▶ For Scanner model the IO-Link channel will be specified in the Explicit Message data field

# Parameter addressing

## Unconnected Request



Service	Class	Instance	Attribute	Data
Standard CIP Services, e.g. Get/Set	IO-Link Device Parameter Object	= IO-Link Index	= IO-Link Sub-Index	

# Data Type Conversion

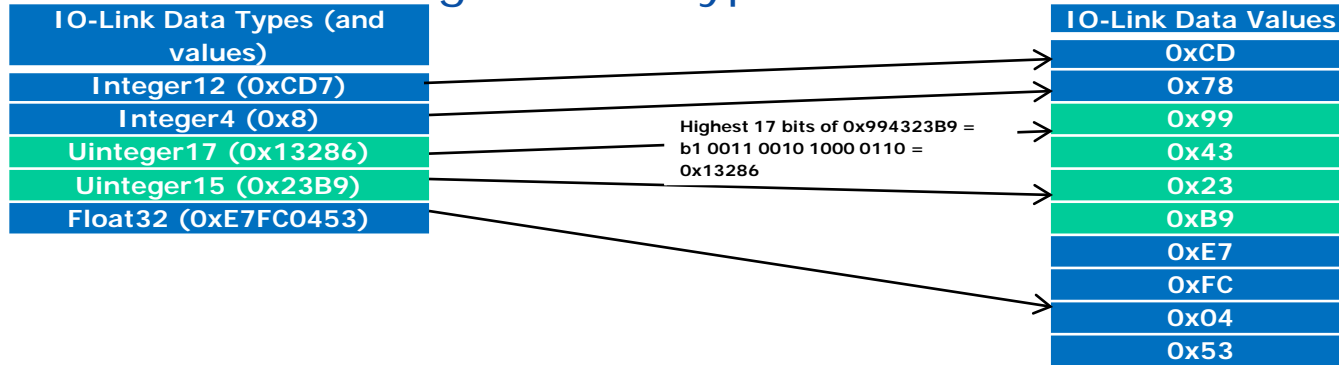
- ▶ IO-Link data types are different than CIP data types (e.g. IO-Link defines 12 bit integers)
- ▶ IO-Link data is transmitted in big endian order versus little endian for CIP data
- ▶ IO-Link Master device will convert between IO-Link and CIP data types
- ▶ IO-Link Master will be provided IO-Link data type information for the I/O or attributes being accessed
- ▶ Rules will be defined for converting IO-Link data types to/from CIP data types

# Data Type Conversion

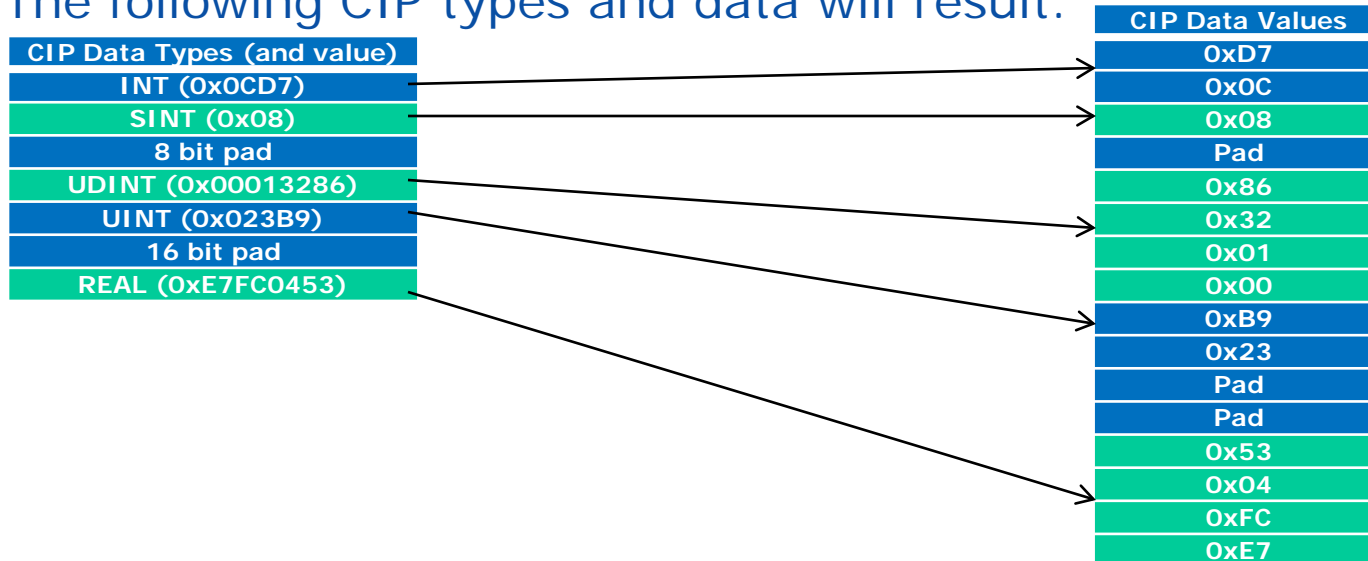
- ▶ For direct I/O connections, IO-Link data type format will be provided in the forward open data segment (Virtual CIP router IO-Link Master)
- ▶ For consolidated I/O connections, IO-Link data type format will be provided as part of the scanlist configuration (Scanner and Mixed IO-Link Master)
- ▶ For parameter access, new services will be defined that provide the IO-Link data type format information
  - Access to untranslated data might be defined using new services
- ▶ Existing Get/Set services could be used if IO-Link Master already has IO-Link data type translation information

# Data Type Conversion example

Given the following IO-Link types and data information:



The following CIP types and data will result:





# I ODD to EDS conversion

- ▶ I ODD files provide the “device class” information for IO-Link target devices
  - This information includes device identity, I/O data information and parameter information
- ▶ EDS files provide the “device class” information for CIP devices
- ▶ Rules will be defined to convert I ODD content into its EDS equivalent
- ▶ The expectation is that CIP configuration tools will convert I ODD files to their EDS equivalent on the fly

- ▶ Two or three IO-Link Master device profiles will be created
- ▶ The Port Object definition will be updated to define an IO-Link port type for an IO-Link subnet
- ▶ IO-Link Link Object will be defined for Virtual CIP router and Mixed models
- ▶ IO-Link Master startup behavior will be defined, this includes dependence on CIP client and configuration handling
- ▶ IO-Link Master configuration mechanism will be defined for the Scanner and Mixed models
- ▶ IO-Link Master Object for Mixed and Scanner models

# Questions?