PLCopen UA Functionblocks
MES Communication via OPC UA

- Success story-

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Agenda

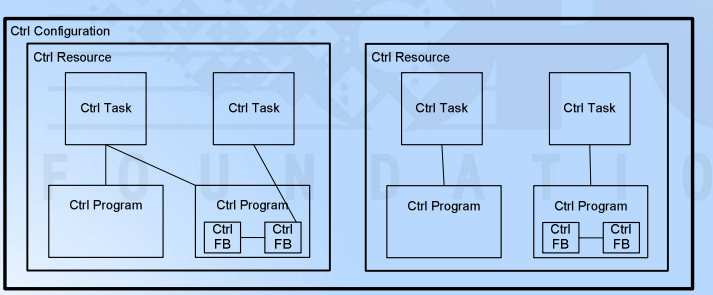
- Cooperation with PLCopen
  - Motivation
  - Timeline
  - Results
  - Demo
  - Team members
  - Current status
- Cooperation with MES
  - Motivation
  - Team members
  - Success story
  - Vision

PLCopen Overview

PLCopen : www.plcopen.org

PLCopen
for efficiency in automation

- Global standard for Industrial Control Programming
- IEC61131-3: Global standard for Industrial Control Programm
- Languages: ST, IL, LD, FBD, structuring tool SFC
- Software model



*The prefix Ctrl is there to avoid conflicts with the OPC UA terminology

PLCopen & OPC Group: Motivation

- PLC controllers executing identical PLC-IEC 61131-3 logic should
  - provide identical protocol access for data exchange
    provide integrated standardized UA access in controller
  - provide identical complete information model about IEC6-1131-3 logic
- Establish easier data exchange
  - Vertical: between SCADA/MES/ERP with PLC
  - Horizontal: between PLC to PLC
- Advantages:
  - Rapidly engineering for UA – clients
    - HMI: create re-useable HMI faceplates
    - MES/ERP: identical access to data profiles in shop floor devices

    → Transparent access to the information in the PLC controller in a secure way

PLCopen & OPC Group: Timeline

V1.0

2008 October: Kick off meeting common group

- Chairman Stefan Hoppe (Beckhoff)
  OPC Editor Matthias Damm (ascolab)
  PLCopen Editor Prof. Rene Simon (ifak)
- Goal V1: Common Namespace for IEC 61131-3 Information model
- Goal V2: PLCopen-OPC-UA function blocks and services

2009 November: V0.9 Release Candidate available

- Live demo on SPS/IPC/Drives 2009

2010 March: V1.0 Released from both organizations

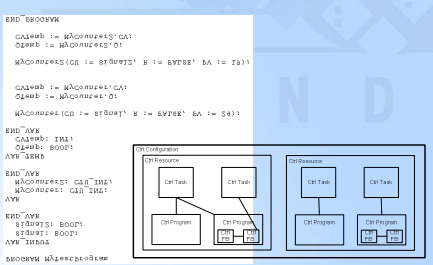
- multi vendor demo at April-2010 Light&Building and Hanover Fair

V2.0

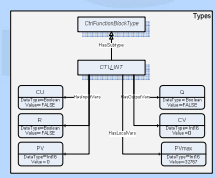
2010 December: continue with goals V2
2012 November: Live demo

Scope joined working group

- Joined working group PLCopen and OPC Foundation
- Main scope for V1.0 is mapping of IEC 61131-3 to OPC UA
  - Focus on content of IEC 61131-3 specification
  - IEC 61131-3 software model → UA object types
  - IEC 61131-3 data types → UA data types
  - IEC 61131-3 variable qualifiers → UA properties
- UA properties and attributes → PLCopen XML export
  - OPC UA base concepts like AccessLevel not covered by IEC 61131-3

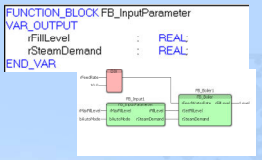


V 1.0



PLCopen and OPC: Results

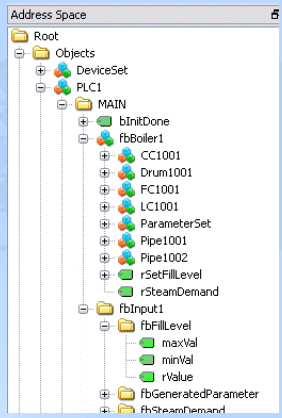
PLCopen:
Content „WHAT“



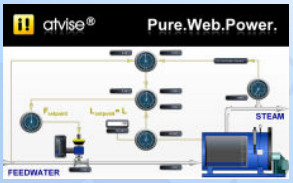
All information about IEC61131-3 project:

- FB‘s
- POU‘s
- Structures
- Tasks / Resources..

OPC-UA-Server:
Communication „HOW“



UA-Clients: SCADA/MES/ERP
Presentation



- Standardized UA access
- Identical namespace
- Complete information model

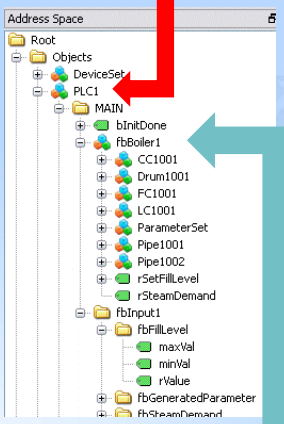
Advantages:
- Re-useable HMI Faceplates“
- Rapidly engineering
- Transparent PLC controller

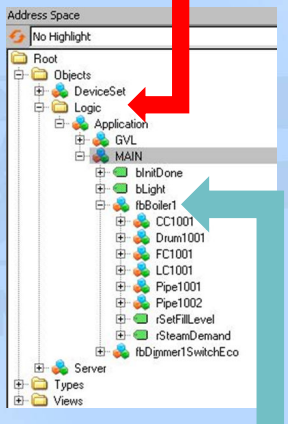
PLCopen and OPC: Results

Beckhoff
„PLC1“

Bosch-Rexroth
„Logic“

Different entry point

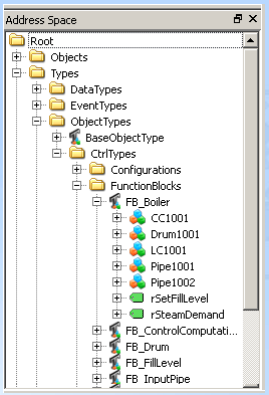




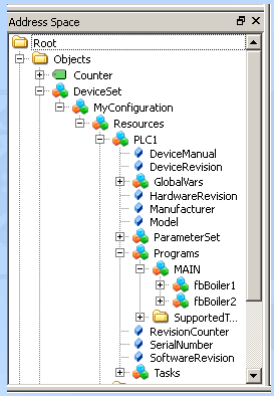
... but semantic identical objects!

Entry points into Address Space

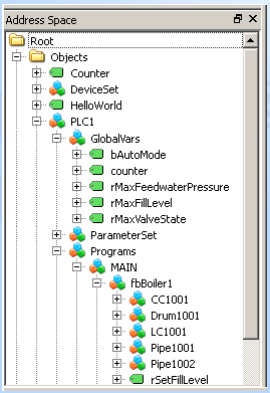
Object types based on Function Blocks



Full object hierarchy below DeviceSet



Entry point for DA Clients like HMI

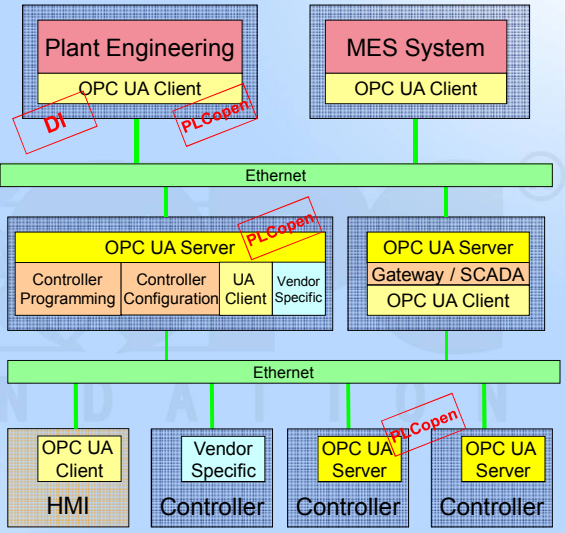


Adoption of PLCopen Model

- OPC UA Server
  - Servers embedded in PLCs or Servers aggregating PLC data on a PC need to implement the PLCopen model and the mapping of Function Blocks to OPC UA object types and instances
  - Full information for Use Cases Engineering and Service is only provided by special servers that have also access to PLC engineering
- OPC UA Client
  - **Clients for Use Cases Observation and Operation (HMI) do not need to know anything about the PLCopen model**
  - But HMI clients can benefit from the object model for rapid HMI configuration
  - OPC UA HMI clients can be embedded too
  - Only engineering clients need to know the PLCopen model

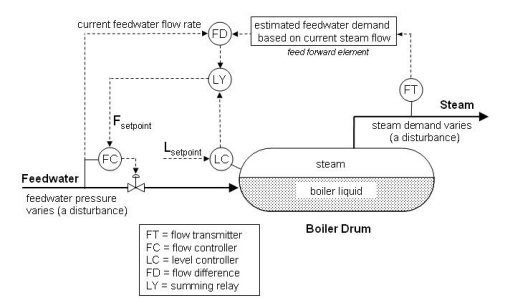
System Architecture PLCopen

- Enterprise systems
- Plant engineering
- Asset management
- PC bases Systems
  - PLC Programming Tools – access to configuration
  - SCADA
- Embedded Devices
  - Access to FB and Variables
  - RTOS



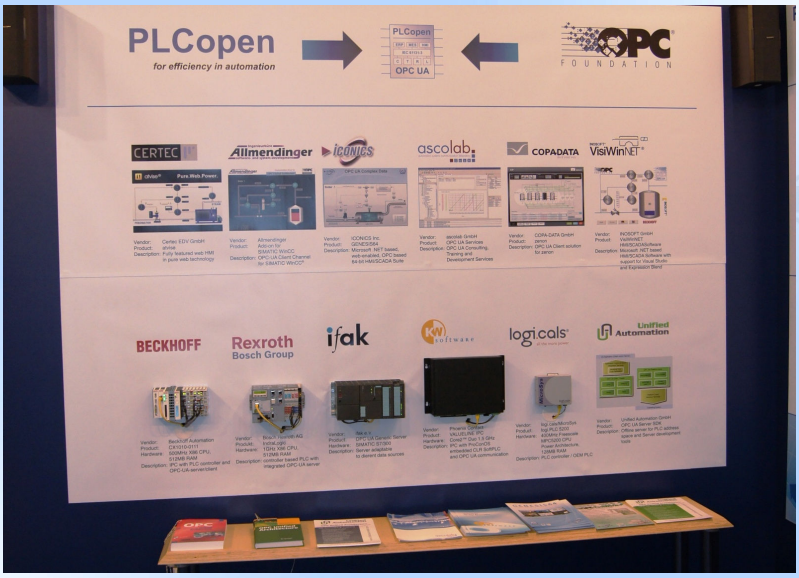
PLCopen & OPC: Demo (1/3)

- Demo at Light&Building 2010 and Hanover trade show 2010
  - provide PLCopen IEC 61131-3 code (ST) to demo a boiler scenario demo with configuration, resources, tasks, programs, function blocks, global and local variable definition



  - run boiler demo on 6 different vendor controllers

PLCopen and OPC: Demo



PLCopen and OPC: Team members

PLCopen & OPC UA: Interoperability On The Next Level

- Enables OPC interfaces in embedded controller
- PLC information model in a standardized format
- Rapid engineering for HMI / MES / ERP
- Moving information from shop floor to enterprise
- Secure, remote “out-of-the-PLCopen-box” communication

ascolab. ABB SIEMENS PLCopen ERP MES HMI IEC 61131-3 C T R L OPC UA iCONICS CERTEC VisiWinNET HIMA SAFETY NONSTOP BECKHOFF Unified Automation Smart Software Solutions ifak KW software Rexroth Bosch Group Allmendinger COPADATA SAP logicals all the more power

PLCopen & OPC: Current status

- 2010 March: V1.0 released by both organizations
- 2010 November Extended Demo with more vendors
  - SPS / IPC / Drives show in Nuremberg / Germany
  - Manufacturing Open Forum 2010 in Tokyo / Japan
- 2010 End Year: First meetings for future activities
  - Additional standardization of PLCopen and OPC
    - Focus on additional features
    - Mapping of Sequential Function Charts (SFC)
    - Standard PLC-UA communication function blocks
    - Standard function blocks for Alarm handling and mapping to OPC UA Alarms and Conditions
    - Best practice guidelines for using OPC UA concepts like Methods, Events, Alarms & Conditions, Historical Access and Programs

PLCopen & OPC: Current status

Define IEC-FB's

for UA-client communication functionality

for UA diagnostic (UA client and UA server)

for file transfer via OPC-UA

Define PLCopen/OPC-UA Interoperability project

At OPC-UA IOP we have all same "IEC-UA-Server" test project

Automatic test-client is next step

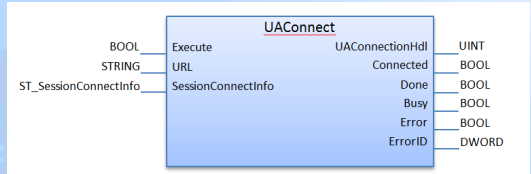
Certification of PLCopen/OPC-UA spec can be tested easily

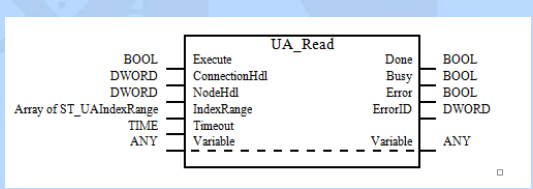
PLCopen & OPC: Current status

FUNCTIONSBLOCKS

Data Communication

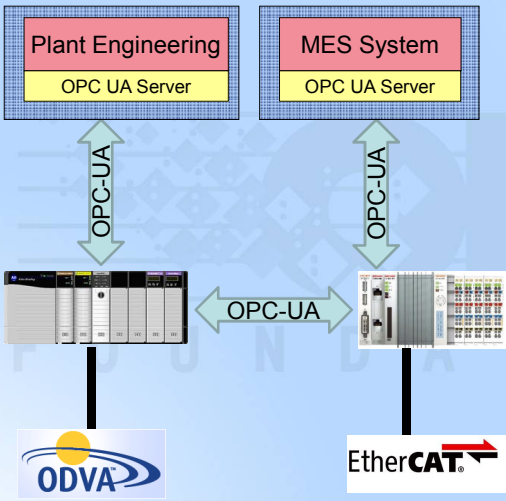
- UaConnect
- UaNodeGetHandle
- UaNodeReleaseHandle
- UaNodeGetInfo
- UaMonitoredItemCreate
- UaMonitoredItemDelete
- UaRead
- UaReadList
- UaWrite
- UaWriteList
- UaMethodGetHandle
- UaMethodReleaseHandle
- UaMethodGetInfo
- UaMethodCall





PLCopen & OPC: Current status

Scenarios for data communication:



PLCopen & OPC-UA-FB's:
- Vertical communication
- Horizontal communication
- Fieldbus independent

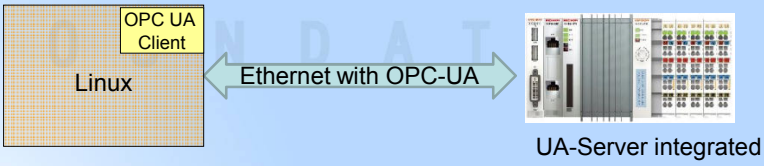
It's fast – but not a fieldbus!

PLCopen & OPC: Current status

Scenarios for data communication:

OPC-UA is not a fieldbus (not deterministic) - but fast!

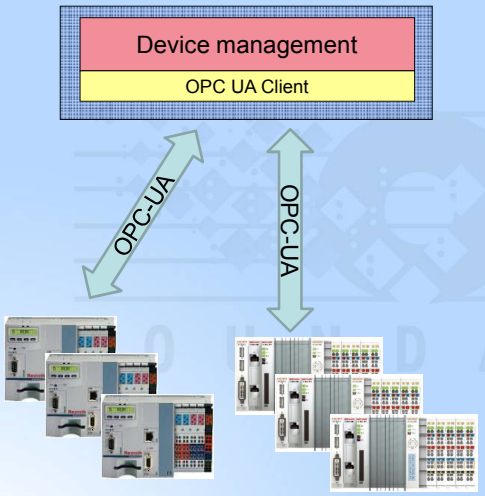
Client : UA Expert (Ascolab) on Linux OS
Server : TwinCAT-PLC (Beckhoff) on Windows Embedded CE
Time : in average 1.8ms (1 node with 256bytes)



UA-Server integrated

PLCopen & OPC: Current status

Scenarios for data communication



1. Easy deployment via download

- e.g. of PLC binary code
- e.g. of recipes

2. Easy management for Upload
- e.g. measurement data

Target market

- Building automation
- Water treatment
- Wind farms

PLCopen & OPC: Current status

FUNCTIONSBLOCKS

for UA diagnostic (UA client and UA server)

Diagnosis

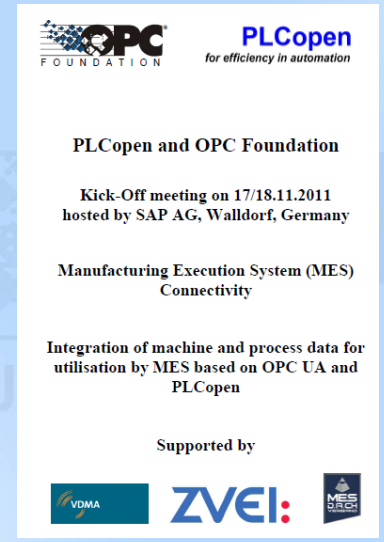
UaConnectionGetStatus
UaServerGetStatus
UaServerGetInfo
UaSessionGetList
UaSessionGetInfo
UaSubscriptionGetList
UaSubscriptionGetInfo

More Information

- OPC Foundation www.opcfoundation.org
  - All information about OPC-UA in general
  - Free download of PLCopen/OPC-UA specification
  - See Downloads → Specifications → OPC UA for IEC 61131-3
- PLCopen www.plcopen.org
  - Free download of introduction papers
  - See TC4 - Communication

PLCopen
for efficiency in automation

OPC & PLCopen: MES Connectivity



OPC & PLCopen: MES Connectivity

Start:

- 2011 November 17/18th : MES-Connectivity hosted by SAP
  - Create PLCopen FB's and complex data structures which provide MES informations to be transported via OPC-UA

Goals:

- Definition of communication mechanisms via OPC UA for MES integration
- Definition of the semantics for MES integration
- Connectivity from MES down into controllers to be easy and fully secured based on PLCopen & OPC-UA technology
- Fieldbus independent

OPC & PLCopen: MES Connectivity

MES-Connectivity

- Team members:

  3S, ABB, Ascolab, Beckhoff, Bosch, Bosch-Rexroth, Continental, EDAG, Fraunhofer- IOSB, Honeywell, ITAC, Leikon, MES-DACH, NAMUR-MES, PSI, Rockwell, RWTH Aachen, SAP, Siemens, Trebing&Himstedt, ifak, Uni Dresden, VDMA, ZVEI

- IMPORTANT:
  - PLCopen & OPCF do not define new MES standards
  - Instead cooperate with VDMA, ZVEI, others to let MES experts define the content
  - OPC-UA just provides transport & security

Success Story

Company Elster Germany:

Connect top floor (SAP ME)

via OPC-UA

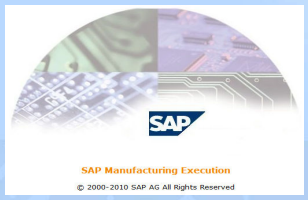
to shop floor (Beckhoff PLC)

Elster on the glance

Elster Markets

Global Market			
Upstream	**Transmission**	**Metering** Gas, Water, Electricity	**Utilization** Heating, Process Heat
			
elster Instromet	elster	elster Kromschröder	

Elster MES Infrastructure



Web Service

SAP Plant Connectivity (PCo)

BECKHOFF

PLC with integrated
OPC UA Server

LabVIEW

Key benefits OPC UA

Roland Essmann
is responsible for the SAP MES implementation at Elster GmbH, Germany. In this role he is the key link between Manufacturing IT, MES and ERP

Benefits of OPC-UA:

- easy to use for PLC programmers and MES team
- standarized interface layer
  - that means PLC vendor and MES communicates without any customizing
  - Ethernet as common connection layer
  - includes security out of the box
- no more DCOM stuff, firewall friendly port usage
- complex data types

Key challenges MES Interfaces

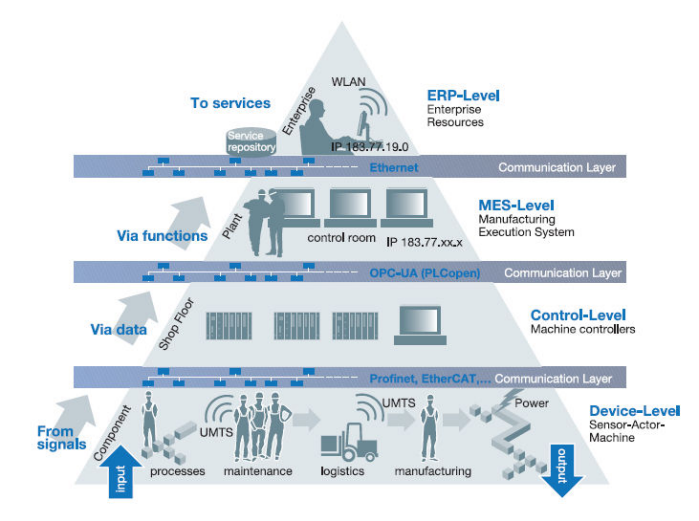
- terminology & variable structure
- speed, reliability

Physical	Communication	Semantic
✓	✓	✗
	OPC™ Openess Productivity Collaboration Unified Architecture	?

Upcomming...

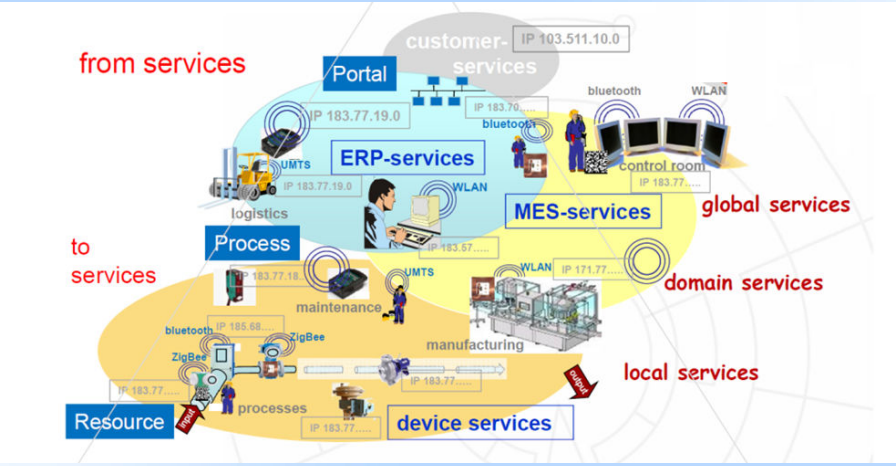
From Controller to IT Level

Today: “From signal -> via data (OPC-tags) -> via functions –> to services”



From Controller to IT Level

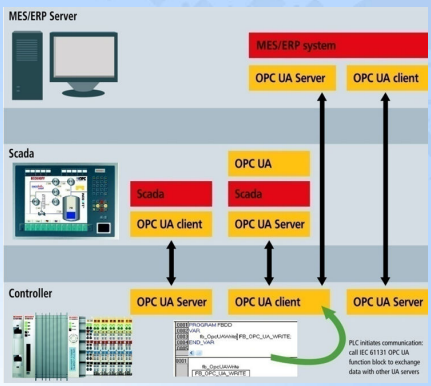
Soon: “From services -> to services”

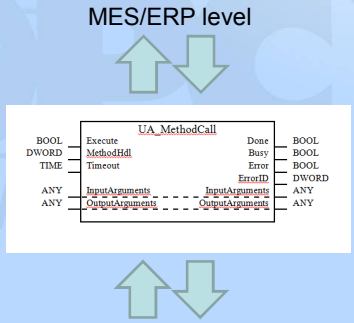


From Controller to IT Level

Today: - HMI or MES initiate communication (act as client)
- Controller answer (act as server), variables & complex data

Soon: - HMI or MES additionally act as server provide methods
- Controller additionally act as client call methods via FB's





Thanks!

Questions ?

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MES Communication via OPC UA

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