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Oblika izmenjave tehničnih podatkov za uporabo v industrijskem inženiringu avtomatizacije sistemov - Označevalni jezik za avtomatizacijo - 5. del: Komunikacija

Engineering data exchange format for use in industrial automation systems engineering - Automation Markup Language - Part 5: Communication

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25.040.40	Merjenje in krmiljenje industrijskih postopkov	Industrial process measurement and control
35.060	Jeziki, ki se uporabljajo v informacijski tehniki in tehnologiji	Languages used in information technology
35.240.50	Uporabniške rešitve IT v industriji	IT applications in industry

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TITLE:

Engineering data exchange format for use in industrial automation systems engineering - Automation Markup Language - Part 5: Communication

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**ENGINEERING DATA EXCHANGE FORMAT FOR USE IN INDUSTRIAL
AUTOMATION SYSTEMS ENGINEERING - AUTOMATION MARKUP
LANGUAGE**

168

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Part 5: Communication

172

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207 The text of this International Standard is based on the following documents:

FDIS	Report on voting
XX/XX/FDIS	XX/XX/RVD

208

209 Full information on the voting for the approval of this International Standard can be found in the
210 report on voting indicated in the above table.

211 This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

212 The committee has decided that the contents of this document will remain unchanged until the
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214 the specific document. At this date, the document will be

- 215 • reconfirmed,
216 • withdrawn,
217 • replaced by a revised edition, or
218 • amended.
219

220 The National Committees are requested to note that for this document the stability date is
221 this text is included for the information of the national committees and will be deleted at the
222 publication stage.

223

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ENGINEERING DATA EXCHANGE FORMAT FOR USE IN INDUSTRIAL AUTOMATION SYSTEMS ENGINEERING - AUTOMATION MARKUP LANGUAGE

Part 5: Communication

1 Scope

Engineering processes of technical systems and their embedded automation systems have to be executed with increasing efficiency and quality. Especially since the project duration tends to increase as the complexity of the engineered system increases. To solve this problem, the engineering process is more often being executed by exploiting software based engineering tools exchanging engineering information and artefacts along the engineering process related tool chain.

Communication systems establish an important part of modern technical systems and, especially, of automation systems embedded within them. Following the increasing decentralisation of automation systems and the application of fieldbus and Ethernet technology connecting automation devices and further interacting entities have to fulfil special requirements on communication quality, safety and security. Thus, within the engineering process of modern technical systems, engineering information and artefacts relating to communication systems also have to be exchanged along the engineering process tool chain.

In each phase of the engineering process of technical systems, communication system related information can be created which can be consumed in later engineering phases. A typical application case is the creation of configuration information for communication components of automation devices including communication addresses and communication package structuring within controller programming devices during the control programming phase and its use in a device configuration tool. Another typical application case is the transmission of communication device configurations to virtual commissioning tools, to documentation tools, or to diagnosis tools.

At present, the consistent and lossless transfer of communication system engineering information along the complete engineering chain of technical systems is unsolved. While user organisations and companies have provided data exchange formats for parts of the relevant information like FDCML, EDDL, and GSD the above named application cases cannot be covered by a data exchange format. Notably the networking related information describing communication relations and their properties and qualities cannot be modelled by a data exchange format.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60027 (all parts), *Letter symbols to be used in electrical technology*

IEC 60050, *International Electrotechnical Vocabulary*

IEC 62424:2008, *Representation of process control engineering - Requests in P&I diagrams and data exchange between P&ID tools and PCE-CAE tools*

ISO/IEC 9834-8, *Information technology - Open Systems Interconnection - Procedures for the operation of OSI Registration Authorities: Generation and registration of Universally Unique Identifiers (UUIDs) and their use as ASN.1 Object Identifier components*

- 273 IEC 62714-1, *Engineering data exchange format for use in industrial systems engineering –*
274 *AutomationML, Architecture and general requirements*
- 275 IEC 62714-2, *Engineering data exchange format for use in industrial systems engineering –*
276 *AutomationML, Role Libraries*
- 277 IEC 62714-4, *Engineering data exchange format for use in industrial systems engineering –*
278 *AutomationML, Logic*
- 279 ISO 80000-1, *Quantities and units – Part 1: General*
- 280 Extensible Markup Language (XML) 1.0:2004, *W3C Recommendation (available at*
281 *<<http://www.w3.org/TR/2004/REC-xml-20040204/>>)*
- 282 IEC 61158, *Industrial communication networks – Fieldbus specifications*
- 283 IEC 61784, *Industrial communication networks – Profiles*
- 284 IEC 61346, *Industrial systems, Installations and Equipment and Industrial Products –*
285 *Structuring Principles and Reference Designations*
- 286 IEC 61131-10, *Programmable controllers – Part 10: PLCopen XML exchange format, 2019*

287 **3 Terms, definitions, abbreviated terms and acronyms**

288 **3.1 Terms and definitions**

289 For the purpose of this document, the terms and definitions given in IEC 62714-1 as well as the
290 following apply.

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291 **3.1.1**

292 **AutomationML / AML**

293 XML based data exchange format for plant engineering data

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294 **3.1.2**

295 **Automation object**

296 entity in an automated system

297 Note 1 to entry: An example of an automation object is an automation component, a valve, or a signal.

298 **3.2 Abbreviated terms and acronyms**

299 For the purpose of this document the abbreviations apply.

AML	Automation Markup Language
CAEX	Computer Aided Engineering Exchange
ECAD	Computer aided engineering for electrical engineering
EDDL	Electronic Device Description Language
FDCML	Field Device Configuration Markup Language
GUID	Global Unique Identifier
GSD	General Station Description
ID	Identifier
MCAD	Computer aided engineering for mechanical engineering
PDU	Protocol Data Unit
UML	Unified Modelling Language
UUID	Universal Unique Identifier
XML	Extensible Markup Language

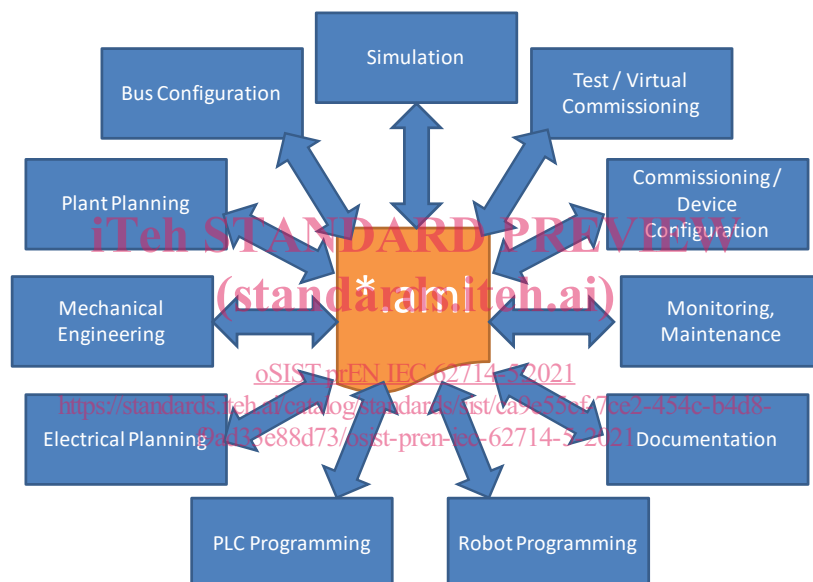
301 4 Use Cases and network structures

302 4.1 General

303 The modelling of communication systems based on AutomationML targets the modelling of a
 304 large amount of information created, exchanged, and applied within the engineering process of
 305 manufacturing systems. Nevertheless, not all possible communication system related
 306 information will be modelled. Within the following clause the use cases for the application of the
 307 communication system modelling as well as the relevant information sets within them are named.

308 4.2 Use Cases

309 Network topology and communication system related information is relevant to various
 310 engineering activities along the engineering chain of production systems. Within the
 311 engineering process of production systems, the communication system can be designed in the
 312 detailed engineering phase exploiting various tools. Thereby, communication system related
 313 information is created which subsequently should be applied within the detailed design of
 314 devices and the device commissioning. Figure 1 represents an example set of engineering
 315 activities relevant within the general engineering process of production systems and the
 316 communication system engineering embedded within.



317

318 **Figure 1 – General Engineering activities communication system engineering is**
 319 **embedded within**

320 Within the named engineering activities, engineering tools like (but not limited to) the following
 321 will have a relevant impact:

- 322 • Plant planning tools
- 323 • Mechanical engineering tools (MCAD)
- 324 • Electrical engineering tools (ECAD)
- 325 • Controller programming tools
- 326 • Robot programming tools
- 327 • HMI programming tools
- 328 • OPC system configuration tools
- 329 • Device configuration tools
- 330 • Bus configuration tools
- 331 • Simulation tools
- 332 • SCADA systems

- 333 • Virtual commissioning tools
 - 334 • Documentation tools
 - 335 • Communication system security tools
 - 336 • Communication system management tools
 - 337 • Communication system diagnosis tools
- 338 These tools will create and/or consume communication system related engineering information
339 depending on the use case of the engineering chain.

340 Nevertheless, (among others) there are two main application cases within this engineering
341 chain, where communication system related information should be exchanged between
342 engineering tools. These two use cases are the main target of the modelling of communication
343 systems based on AutomationML.

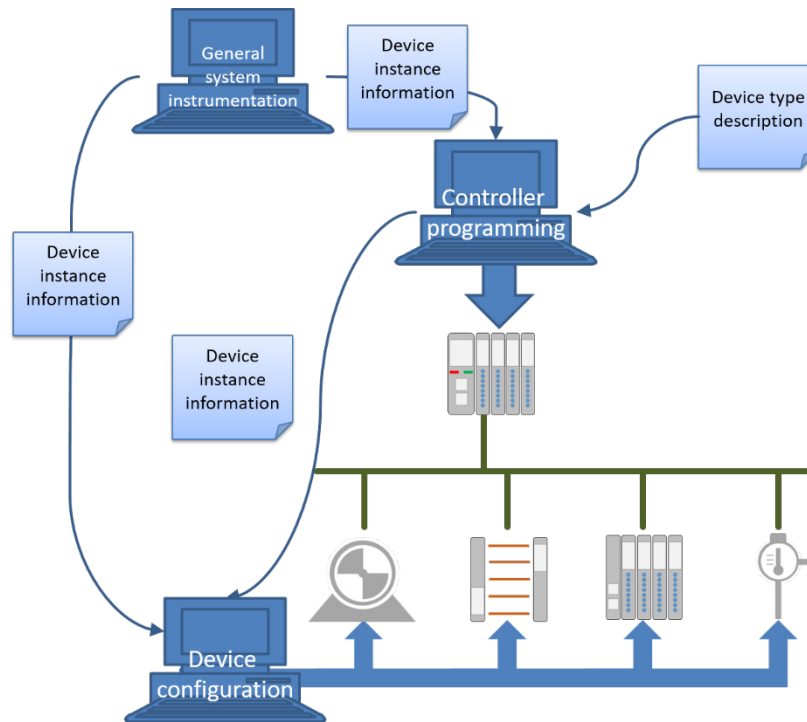
344 **4.2.1 Lossless transfer of communication device instance information**

345 Within the general engineering process, this use case covers the transition of communication
346 relevant information for configuration of communication components of sensors and actuators
347 from controller programming tool and similar tools to sensor and actuator configuration /
348 programming tools. It contains the transition of information relevant for correct communication
349 (like addresses and channels) as well as for correct structuring of communication data packages
350 transmitted within communication (like transmitted data points of sensors).

351 Within the related engineering activities engineers with the engineering roles of controller
352 programmer, HMI programmer, electrical design engineer, commissioner communication,
353 commissioner controller, and robot programmer can be involved. They will execute the following
354 sequence of engineering and data exchange activities which has to be seen as an example
355 sequence.

- 356 Step 1. Design of system instrumentation, definition of used/interconnected devices
- 357 Step 2. Export of device information from system instrumentation tool
<https://standards.iteh.ai/catalog/standards/sist/ca9e55cf-7ce2-454c-b4d8-9a133e68d73/iec-62714-5-2021>
- 358 Step 3. Import of device information to controller programming and device configuration tools
- 359 Step 4. Integration of device descriptions (like GSD) in controller programming tool
- 360 Step 5. Design of controller programs and configurations within controller programming tool
- 361 Step 6. Export of communication device relevant information from controller programming tool
- 362 Step 7. Import of communication device relevant information to device configuration tool
- 363 Step 8. Use of information for parameterisation of communication component of device
364 (addresses, etc.) and for structuring of communication packages (send data points)

365



366
367 **Figure 2 – Information flow of the use case**

368 There are different alternatives possible but not usually applied. The following sequences are
369 imaginable which will be in the focus of the use case.

370 Step 1. Design of communication system configurations within third party tool

371 Step 2. Integration of Device Descriptions prEN IEC 62714-5:2021

372 Step 3. Export of communication device relevant information
<https://standards.iteh.ai/catalog/standards/sist/ca9e55cf-7ce2-454c-b4d8-dad55e88d750/sist-pr-en-iec-62714-5-2021>

373 Step 4. Import of communication device relevant information to device configuration /
374 programming tool

375 Step 5. Use of information for parameterization of communication component of device
376 (addresses, etc.) and for structuring of communication packages (send data points)

377

378 Step 1. Third party tool, e.g. the device configuration tool provides information like signals, data
379 volume, describing the instance information

380 Step 2. Device vendor provides device descriptions, describing the type information

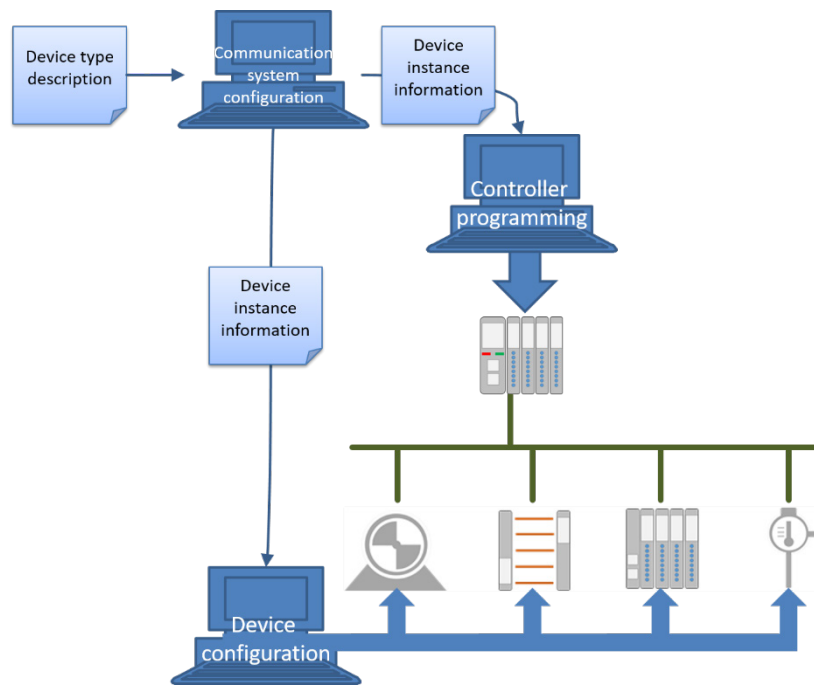
381 Step 3. Bus configuration tool consumes these snippets and device descriptions

382 Step 4. Bus configurator generates bus configuration

383 Step 5. Import of the bus configuration into the controller programming tool

384 Step 6. Use of information from peripheral devices inside the controller program

385 Both sequences are commonly depicted in Figure 3.



386

387

Figure 3 – Alternative information flow of the use case

388 Possible tools exporting communication system information can be e.g. controller programming
 389 tools. They cover controller programming projects with data points (variables), device
 390 configurations, and indirect communication network descriptions. In addition, communication
 391 system engineering tools can be data sources as well as instrumentation tools like ECAD tools.

392 Data sinks of the data exchange can be tools for sensor communication configuration, HMI
 393 programming, robot programming, OPC system configuration, or actor communication
 394 configuration. They mostly cover programming projects with data points (variables), device
 395 configurations, and indirect communication network descriptions. Relevant tools can be FDT
 396 tools, HMI programming tools, and robot programming tools.

397 Based on this use case the modelling of communication systems based on AutomationML has
 398 to cover information about I/O lists, association of variables (I/Os) to communication data
 399 packages and device parameters for parameterization of communication devices such as
 400 addresses (e.g. IP address), media access (e.g. MAC address), subnet masks, gateway
 401 addresses, and communication objects used, such as profile information.

402 In addition the modelling should fulfil the following non-functional requirements. Device
 403 parameter list has to be extendable by users to cover upcoming technologies. Appropriate
 404 RoleClassLibs and/or SystemUnitClassLibs enabling the identification of object semantics have
 405 to be defined.

406 **4.2.2 Lossless transfer of communication system information**

407 Beyond the configuration of communication devices, communication system information is
 408 exploited in different engineering, monitoring, maintenance, etc. tools. Therefore, this use case
 409 covers the transmission of communication network configuration and structure information
 410 including infrastructure device configuration, end device configuration with respect to
 411 communication system parameters, network structure and wiring, quality of service, etc. This
 412 information shall be provided to device configuration tools, documentation and maintenance
 413 tools, and network management tools. They shall enable the combination of physical wiring with
 414 logical communication connections for error detection.

415 Within this use case engineers with the engineering roles controller programmer, HMI
 416 programmer, electrical design engineer, commissioner communication, commissioner controller,
 417 robot programmer, and operator are involved. They will execute the following engineering
 418 process which has to be seen as an example sequence.