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OPC unified architecture - Part 21: Device onboarding

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TITLE:

OPC Unified Architecture – Part 21: Device Onboarding

PROPOSED STABILITY DATE: 2026

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OPC UNIFIED ARCHITECTURE –

Part 21: Device Onboarding

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International Standard IEC 62541-21 has been prepared by subcommittee 65E: Devices and integration in enterprise systems, of IEC technical committee 65: Industrial-process measurement, control and automation.

The text of this international standard is based on the following documents:

CDV	Report on voting
65E/XX/CDV	65E/XX/RVC

Full information on the voting for the approval of this international standard can be found in the report on voting indicated in the above table.

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187 *Italics* are used to denote a defined term or definition that appears in the “Terms and definition” clause
188 in one of the parts of the series.

189 *Italics* are also used to denote the name of a service input or output parameter or the name of a structure
190 or element of a structure that are usually defined in tables.

191 The *italicized terms* and *names* are also often written in camel-case (the practice of writing compound
192 words or phrases in which the elements are joined without spaces, with each element's initial letter
193 capitalized within the compound). For example, the defined term is *AddressSpace* instead of Address
194 Space. This makes it easier to understand that there is a single definition for *AddressSpace*, not
195 separate definitions for Address and Space.

196 A list of all parts of the IEC 62541 series is included in IEC 62541-1 clause 4 Structure of the OPC UA
197 series and published under the general title OPC Unified Architecture, can be found on the IEC website.

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199 date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific
200 publication. At this date, the publication will be

- 201 • reconfirmed,
- 202 • withdrawn,
- 203 • replaced by a revised edition, or
- 204 • amended.

205

206 A bilingual version of this publication may be issued at a later date.

207

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OPC UNIFIED ARCHITECTURE

Part 21: Device Onboarding

218 **1 Scope**

219 This part defines the life cycle of *Devices* and *Composites* and mechanisms to verify their
220 authenticity, set up their security and maintain their configuration.

221 **2 Normative references**

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

226 IEC 62541-1, *OPC Unified Architecture – Part 1: Overview and Concepts*

227 IEC 62541-2, *OPC Unified Architecture – Part 2: Security*

228 IEC 62541-3, *OPC Unified Architecture – Part 3: Address Space Model*

229 IEC 62541-4, *OPC Unified Architecture – Part 4: Services*

230 IEC 62541-5, *OPC Unified Architecture – Part 5: Information Model*

231 IEC 62541-6, *OPC Unified Architecture – Part 6: Mappings*

232 IEC 62541-7, *OPC Unified Architecture – Part 7: Profiles*

233 IEC 62541-9, *OPC Unified Architecture – Part 9: Alarms and Conditions*

234 IEC 62541-12, *OPC Unified Architecture – Part 12: Discovery and Global Services*

235 IEC 62541-14, *OPC Unified Architecture – Part 14: PubSub*

236 IEC 62541-22, *OPC Unified Architecture – Part 22: Base Network Model*

237 IEC 62541-100, *OPC Unified Architecture – Part 100: Device Model*

238

239 ISO/IEC 11889, Information technology — Trusted platform module library

240 <https://www.iso.org/standard/66510.html>

241 802.1AR, Secure Device Identity

242 <https://1.ieee802.org/security/802-1ar/>

243 RFC 3161, Internet X.509 Public Key Infrastructure Time-Stamp Protocol (TSP)

244 <https://tools.ietf.org/html/rfc3161>

245 RFC 5280, Internet X.509 Public Key Infrastructure Certificate

246 <https://tools.ietf.org/html/rfc5280>

247 RFC 7515, JSON Web Signature (JWS)

248 <https://tools.ietf.org/html/rfc7515>

249 RFC 7518, JSON Web Algorithms (JWA)

250 <https://tools.ietf.org/html/rfc7518>

251 RFC 2045, Multipurpose Internet Mail Extensions (MIME) Part One

252 <https://tools.ietf.org/html/rfc2045>

253 RFC 4648, The Base16, Base32, and Base64 Data Encodings

254 <https://tools.ietf.org/html/rfc4648>

255 DIN 91406, Automatic identification of physical objects and information on physical objects in
256 IT systems

257 [https://www.en-standard.eu/din-spec-91406-automatische-identifikation-von-physischen-](https://www.en-standard.eu/din-spec-91406-automatische-identifikation-von-physischen-objekten-und-informationen-zum-physischen-objekt-in-it-systemen-insbesondere-iiot-systemen-text-deutsch-und-englisch/)

258 [objekten-und-informationen-zum-physischen-objekt-in-it-systemen-insbesondere-iiot-](https://www.en-standard.eu/din-spec-91406-automatische-identifikation-von-physischen-objekten-und-informationen-zum-physischen-objekt-in-it-systemen-insbesondere-iiot-systemen-text-deutsch-und-englisch/)

259 [systemen-text-deutsch-und-englisch/](https://www.en-standard.eu/din-spec-91406-automatische-identifikation-von-physischen-objekten-und-informationen-zum-physischen-objekt-in-it-systemen-insbesondere-iiot-systemen-text-deutsch-und-englisch/)

260

261 **3 Terms, definitions, and conventions**

262 **3.1 Terms and definitions**

263 For the purposes of this document the following terms and definitions as well as the terms and
264 definitions given in IEC 62541-1, IEC 62541-2, IEC 62541-3, IEC 62541-4, IEC 62541-6,
265 IEC 62541-9 and IEC 62541-100 apply.

266 **3.1.1**

267 **Application**

268 a program that runs on a *Device* and communicates with other *Applications* on the network.

269 Note 1 to entry: Each *Application* has an identifier that is unique within the network.

270 Note 2 to entry: An *OPC UA Application* is an *Application* that supports OPC UA.

271

272 **3.1.2**

273 **ApplicationUri**

274 a globally unique identifier for an *OPC UA Application* running on a particular *Device*.

275 Note 3 to entry: The *Application Instance Certificate* has the *ApplicationUri* in the *subjectAltName* field.

276 **3.1.3**

277 **Composite**

278 a collection of *Devices* or *Composites* assembled into a single unit.

279 Note 1 to entry: Each *Composite* has a globally unique identifier.

280 Note 2 to entry: A *Composite* may act as a single *Device* when connected to a network.

281 Note 3 to entry: A *Composite* may appear as multiple *Devices* when connected to a network.

282 **3.1.4**

283 **CompositeBuilder**

284 an organization that creates *Composites*.

285 **3.1.5**

286 **CompositeInstanceUri**

287 a globally unique resource identifier assigned by a builder to a *Composite*..

288 **3.1.6**

289 **DCA Client**

290 a DCA which is a *Client* and supports *PullManagement*.

291 **3.1.7**

292 **DCA Server**

293 a DCA which is a *Server* and supports *PushManagement*.

294 **3.1.8**295 **Device**

296 As defined in IEC 62541-100.

297 Note 1 to entry: For this document a *Device* also executes one or more *OPC UA Applications*.298 Note 2 to entry: a generic computer or mobile device may be a *Device* if it has a *DeviceIdentity Certificate*

299

300 **3.1.9**301 **Device Configuration Application (DCA)**302 a *Client* or *Server* installed on a *Device* used to configure other applications installed on the
303 same *Device*.304 Note 1 to entry: a DCA which is a *Client* uses *PullManagement* (see 7.2) to interact with the *Registrar*.305 Note 2 to entry: the *Registrar* uses *PushManagement* (see 7.3) to interact with a DCA which is a *Server*.306 **3.1.10**307 **DeviceIdentity Certificate**308 a *Certificate* issued to a *Device* that identifies the *Device*.309 Note 1 to entry: All *DeviceIdentity Certificates* have the *ProductInstanceUri* as a *subjectAltName*.310 Note 2 to entry: All *DeviceIdentity Certificates* are IDevID or LDevID Certificates as defined by 802.1AR.311 Note 3 to entry: The *ProductInstanceUri* is the *ApplicationUri* when the *DeviceIdentity Certificate* is used to create a
312 *SecureChannel*.313 **3.1.11**314 **Distributor**315 an organization that re-sells *Devices* and/or *Composites*.316 Note 1 to entry: A *Distributor* may enhance *Devices* and *Composites* by adding customized products or services.317 **3.1.12**318 **Manufacturer**319 an organization that creates *Devices*.320 **3.1.13**321 **OwnerOperator**322 an organization deploying and operating a system that comprises of *Devices*, *Composites* or
323 other computers connected via a network.

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<http://standards.iteh.ai/catalog/standards/sist/acc26437-6b60-4b51-a6a7-6ab2ab1629fa/osist-pren-iec-62541-21-2024>324 **3.1.14**325 **Privilege**

326 a named set of permissions or access rights which are needed to perform a task.

327 **3.1.15**328 **ProductInstanceUri**329 a globally unique resource identifier assigned by the manufacturer to a *Device*.330 **3.1.16**331 **Registrar**332 an *OPC UA Application* that registers and authenticates *Devices* added to the network.333 **3.1.17**334 **SystemIntegrator**335 an organization that installs and configures a system for an *OwnerOperator* that comprises of
336 *Devices*, *Composites* or other computers connected via a network.337 **3.1.18**338 **SecureElement**339 a hardware component that protects *Private Keys* from unauthorized access and disclosure.340 **3.1.19**341 **Ticket**342 a document that identifies a *Device* or *Composite* and has a *DigitalSignature*.

343	3.2 Abbreviations and symbols	
344	API	Application Programming Interface
345	ASN.1	Abstract Syntax Notation #1
346	CA	Certificate Authority
347	CRL	Certificate Revocation List
348	DCA	Device Configuration Application
349	DER	ASN.1 Distinguished Encoding Rules
350	DHCP	Dynamic Host Configuration Protocol
351	DNS	Domain Name System
352	ERP	Enterprise Resource Planning
353	GDS	Global Discovery Server
354	IDeVID	Initial Device Identifier
355	LDeVID	Locally Significant Device Identifier
356	LDS	Local Discovery Server
357	mDNS	Multicast Domain Name System
358	NAT	Network Address Translation
359	PKCS	Public Key Cryptography Standards
360	TLS	Transport Layer Security
361	TPM	Trusted Platform Module
362	UA	Unified Architecture
363	URI	Uniform Resource Identifier
364	URN	Uniform Resource Name
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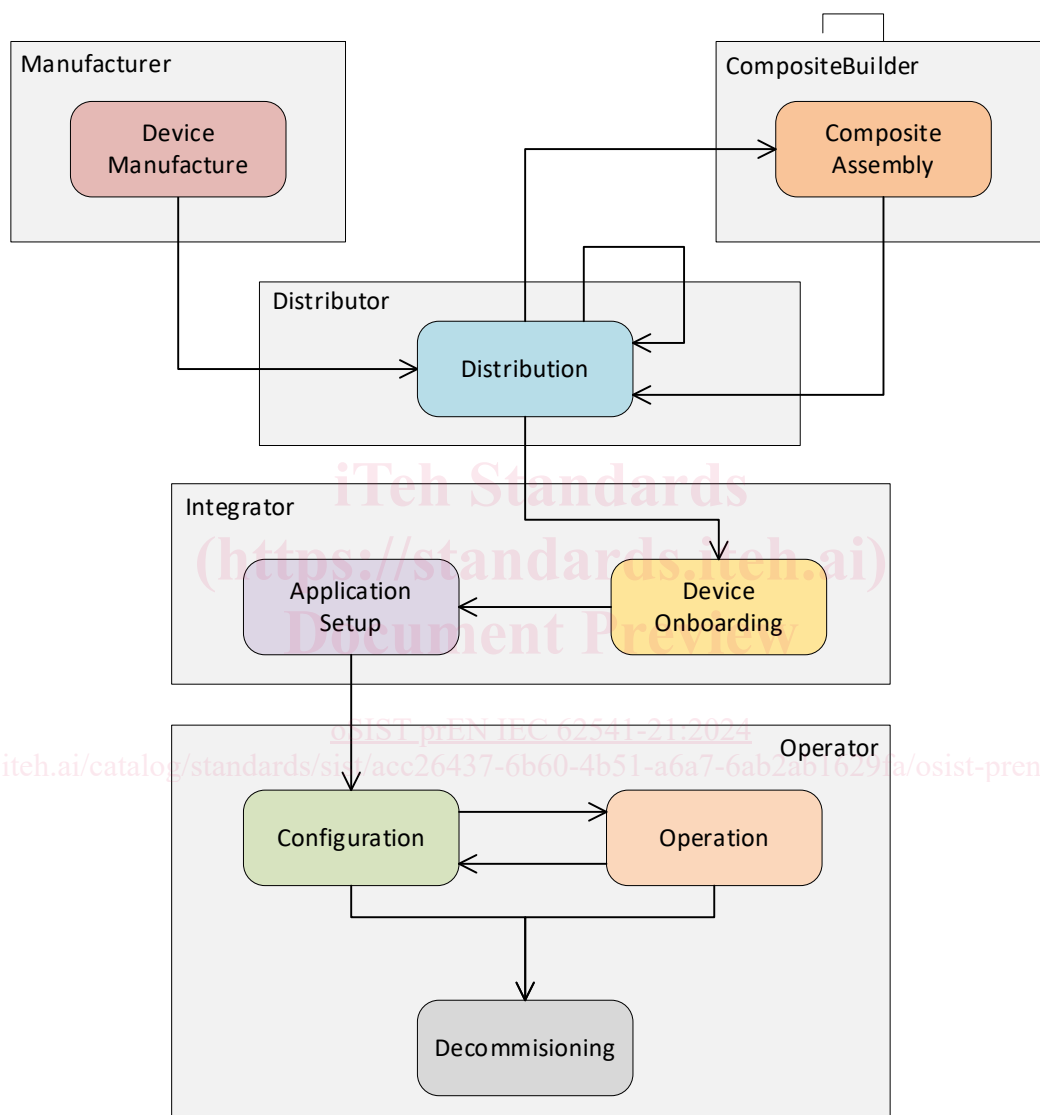
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366 4 Onboarding Model

367 4.1 Device Lifecycle

368 The Onboarding model is designed to allow the configuration of a *Device* to be managed over
 369 the complete lifecycle of the *Device* from manufacture to decommissioning. The entire lifecycle
 370 approach is needed because *Devices*, unlike PC-class computers, are often shipped with
 371 automation software pre-installed and are connected directly to sensitive networks. This
 372 requires a process to authenticate *Devices* before they are given access to a sensitive network.

373 The complete life cycle of a *Device* is shown in Figure 1.



374

375

Figure 1 – The Lifecycle of a Device

376 The actors in the *Device* lifecycle are described in Table 1.

377

Table 1 – The Actors in the Device Lifecycle

Actor	Description
Device	A computer that is able to communicate via a network. A <i>Device</i> has a unique identifier and may have one or more <i>Applications</i> (see 3.1.4)