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Section 1

Introduction and Overview

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Learning objectives

In this section, you will learn …

> … what OPC UA is

> … how OPC UA is different to OPC Classic

> … the advantages offered by OPC UA

> … the OPC UA servers and clients offered by Siemens in its product portfolio

General information about OPC

OPC:

❌ OLE for Process Control (old acronym for the OPC Classic standard)

❌ Openness, Productivity and Connectivity

✅ Open Platform Communications (in use since OPC Unified Architecture (UA))
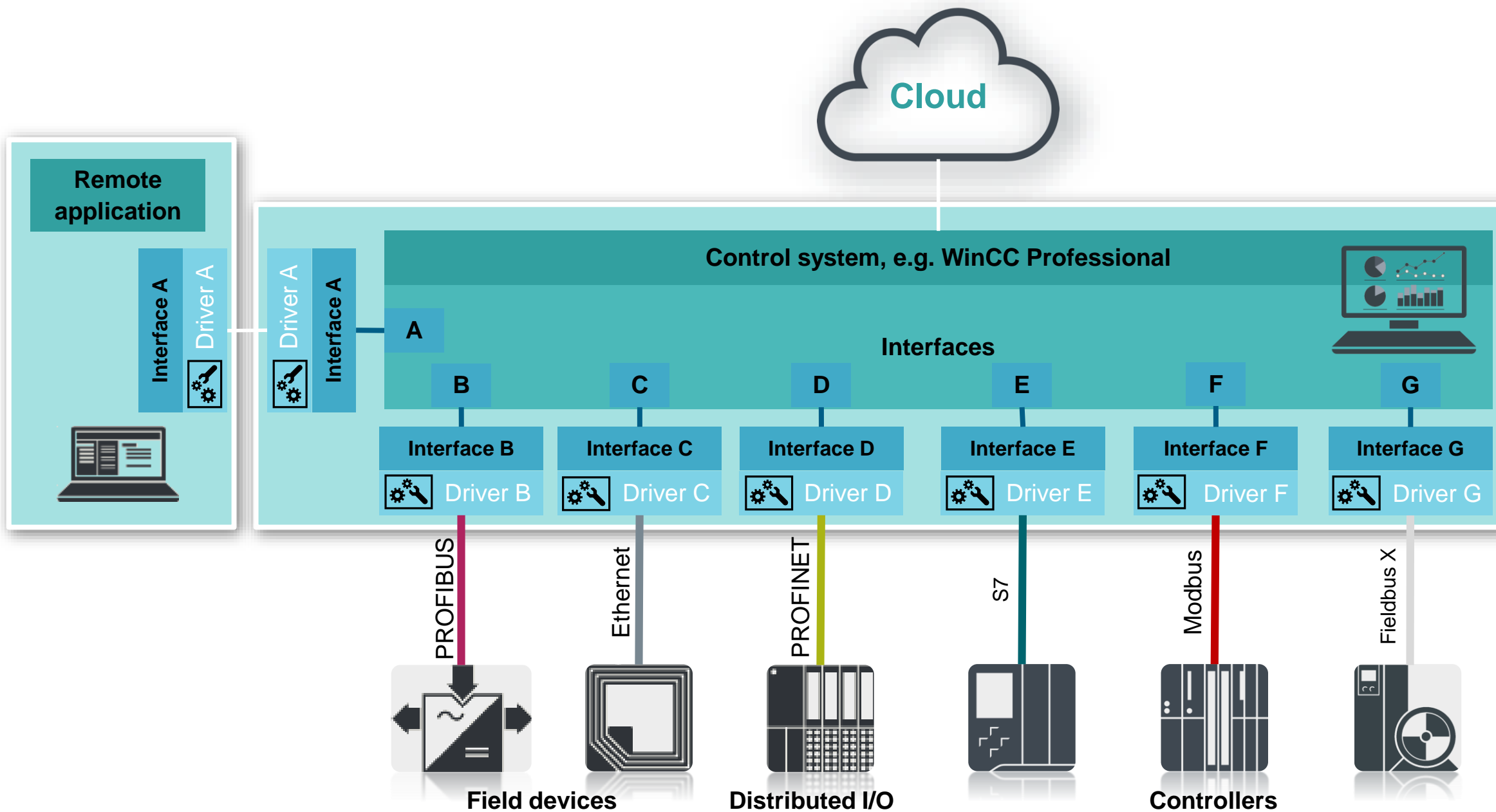
Service for accessing the following information of the production process:
- Variables
- Alarms
- Archive data
- Methods

➢ Data interface for automation technology

➢ Standardized by the OPC Foundation

ℹ Logo of the OPC Foundation for OPC UA:

Office

Cloud

SCADA

Remote application

Interface A

OPC UA

OPC UA communication

OPC UA	OPC UA	OPC UA	OPC UA	OPC UA	OPC UA
Driver B	Driver C	Driver D	Driver E	Driver F	Driver G

PROFIBUS

Ethernet

PROFINET

S7

Modbus

Fieldbus X

Field devices

Distributed I/O

Controllers

Goals of OPC

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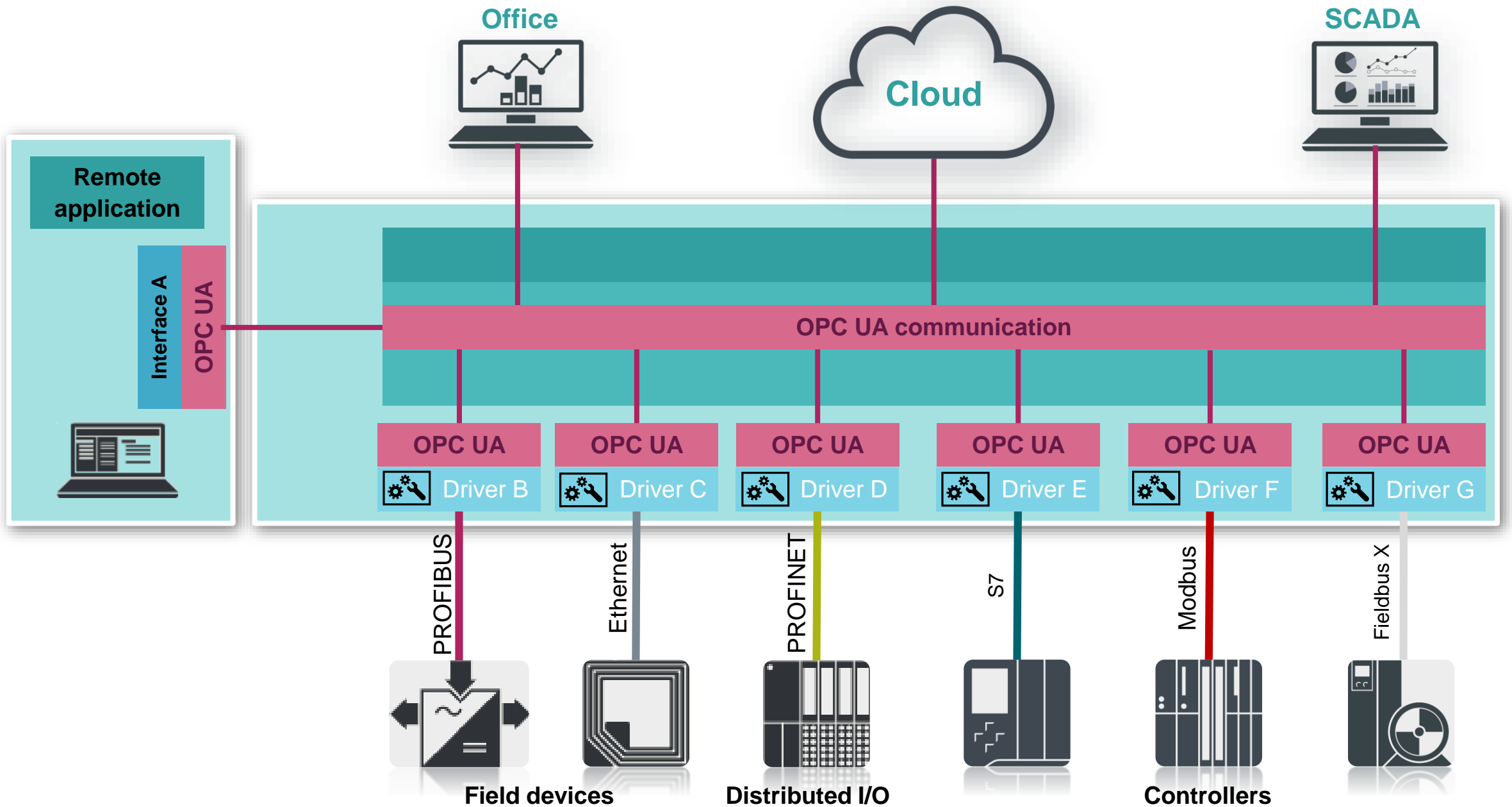
☑ Flexible and efficient data access → Many applications and hardware support OPC

☑ Easy to understand → Can be utilized after just a little training

☑ Easy to implement → Programming examples, libraries

☑ Openness of specification → Available through OPC Foundation, IEC standard

☑ Use of universal and platform-independent devices as data source

☑ Integration in devices on all levels of the automation pyramid

    → With OPC UA, field devices can be <u>directly</u> connected as servers

☑ Comprehensive security → e.g. authorization, authentication, encryption

What OPC is not:

☒ OPC is not a replacement for fieldbus protocols

☒ There is currently no real-time-capable communication at the field level, e.g. PLC, drives, valves, I/O modules

Advantages of OPC

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For end customers

- ☑ Elimination of dependency on exactly one suitable combination of hardware and software

- ☑ Easy connection of devices and applications of different manufacturers

- ☑ OPC servers directly from the hardware manufacturer

- ☑ Integration of various fieldbus systems

- ☑ Certification and compatibility

i

Logos of the OPC Foundation that are awarded when compliance test is passed

SELF-TESTED™ FOR COMPLIANCE OPC® FOUNDATION

CERTIFIED® FOR COMPLIANCE OPC® FOUNDATION

Advantages of OPC

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For software manufacturers:

- ✓ A myriad of special hardware drivers no longer have to be developed

- ✓ Implementation of an OPC interface with client or server functionality

- ✓ No driver modifications after hardware changes

- ✓ Code examples and communication stack available as open source

Advantages of OPC

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For hardware manufacturers:

- ✓ Only one software driver has to be developed as the interface for an OPC server

- ✓ The hardware can be integrated immediately in all OPC-capable applications

- ✓ The server function can be integrated in hardware through developer kits

Highlights of OPC

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- ✓ Convenient interface

- ✓ Comprehensive set operations

- ✓ Asynchronous read and write operations

… OPC UA in detail

- ✓ Industry standards as Companion Specifications

- ✓ Platform independence

- ✓ Cross-vendor interoperability

- ✓ Compact and clearly structured functionality

OPC Foundation
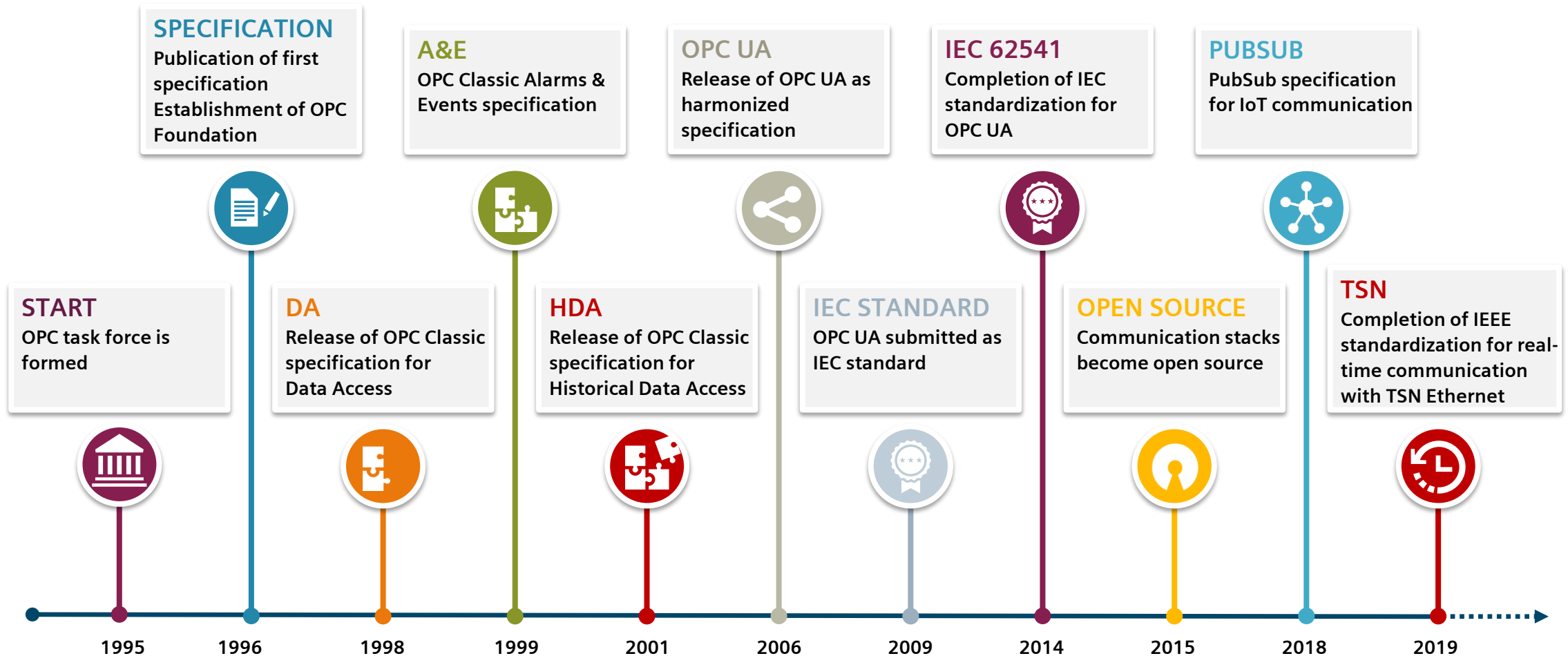
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- Collaboration with industry standards
- Arose from a task force
- Non-profit organization
- Contributors are employees of the participating companies
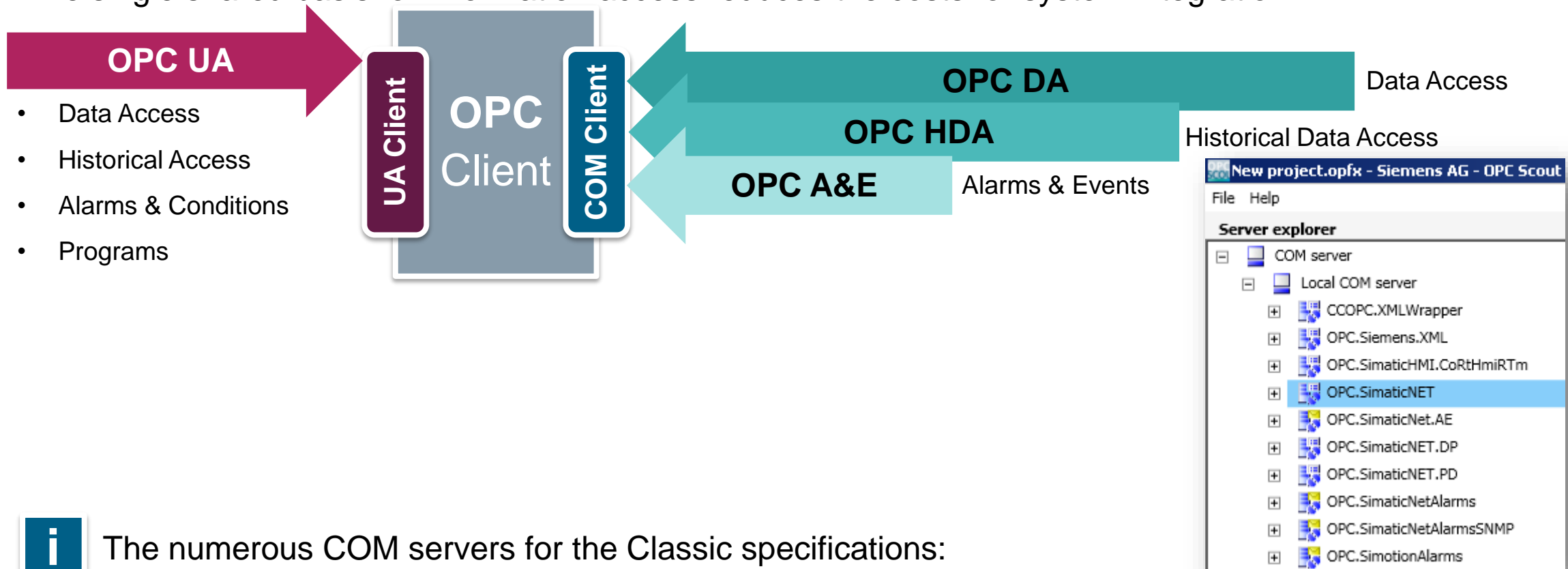- About 600 companies are members of the OPC Foundation

Timeline
Historical evolution from OPC Classic to OPC UA today

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SPECIFICATION
Publication of first specification Establishment of OPC Foundation

A&E
OPC Classic Alarms & Events specification

OPC UA
Release of OPC UA as harmonized specification

IEC 62541
Completion of IEC standardization for OPC UA

PUBSUB
PubSub specification for IoT communication

START
OPC task force is formed

DA
Release of OPC Classic specification for Data Access

HDA
Release of OPC Classic specification for Historical Data Access

IEC STANDARD
OPC UA submitted as IEC standard

OPEN SOURCE
Communication stacks become open source

TSN
Completion of IEEE standardization for real-time communication with TSN Ethernet

| 1995 | 1996 | 1998 | 1999 | 2001 | 2006 | 2009 | 2014 | 2015 | 2018 | 2019 |

OPC UA principle

Uniform access

OPC UA integrates existing OPC Classic specifications – DA, A&E, HA, Programs – in one specification. The single shared basis for information access reduces the costs for system integration.
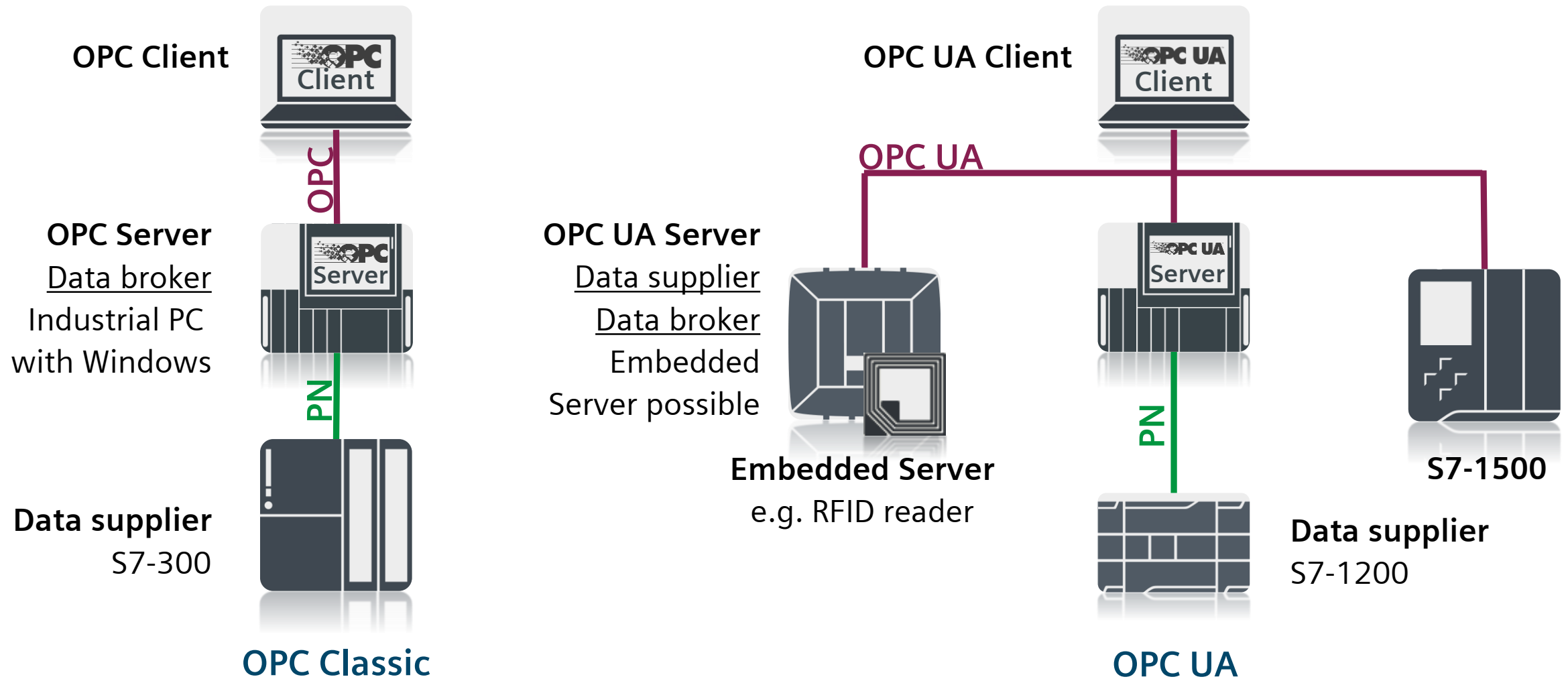

OPC UA

- Data Access
- Historical Access
- Alarms & Conditions
- Programs

UA Client | **OPC Client** | **COM Client**

OPC DA — Data Access

OPC HDA — Historical Data Access

OPC A&E — Alarms & Events

New project.opfx - Siemens AG - OPC Scout

File   Help

Server explorer

- COM server
  - Local COM server
    - CCOPC.XMLWrapper
    - OPC.Siemens.XML
    - OPC.SimaticHMI.CoRtHmiRTm
    - OPC.SimaticNET
    - OPC.SimaticNet.AE
    - OPC.SimaticNET.DP
    - OPC.SimaticNET.PD
    - OPC.SimaticNetAlarms
    - OPC.SimaticNetAlarmsSNMP
    - OPC.SimotionAlarms

ℹ The numerous COM servers for the Classic specifications:

Comparison of OPC Classic and OPC UA

OPC Classic	OPC UA
Communication • COM/DCOM • Component-oriented architecture (CoA)	**Communication** • TCP/IP or XML • Service-oriented architecture (SoA)
Operating system • Windows	**Operating system** • Platform-independent
Security • User name / Password • User administration	**Security** • Certificate-based • Encrypted connection • User name / Password • User administration
Performance • Each access type requires a server • Data transfer without semantic description	**Performance** • A single server is possible • Data transfer and semantic description

Client/server architecture
# Comparison of OPC Classic and OPC UA

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OPC Client

OPC Server
Data broker
Industrial PC
with Windows

OPC

PN

Data supplier
S7-300

OPC Classic

OPC UA Server
Data supplier
Data broker
Embedded
Server possible

Embedded Server
e.g. RFID reader

OPC UA Client

OPC UA

PN

S7-1500

Data supplier
S7-1200

OPC UA

OPC UA in the automation pyramid
Distinction from PROFINET

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Strengths of OPC UA

- Platform-independent
- Direct connection of devices on all levels
- Authentication and encryption
- Semantics services

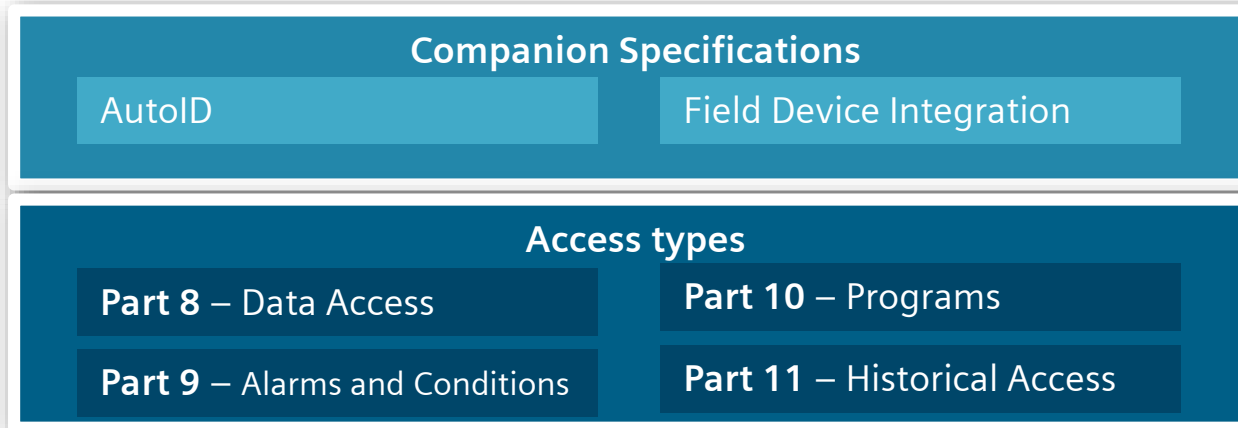**Advantages on the data and management levels**

OPC UA

PROFINET

- Cloud
- Management level
- Operator level
- Controller level
- Field level
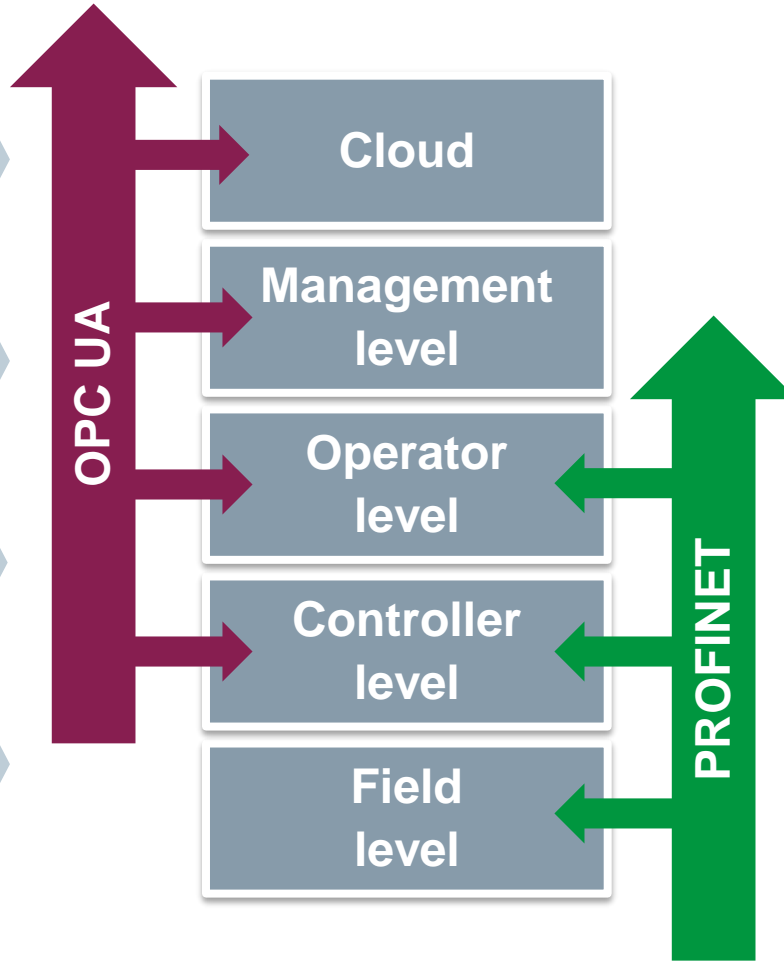
Strengths of PROFINET

- Deterministic
- Real-time-capable
- C2C communication in real time
- Standardized profiles

  PROFIsafe   PROFIenergy   PROFIdrive
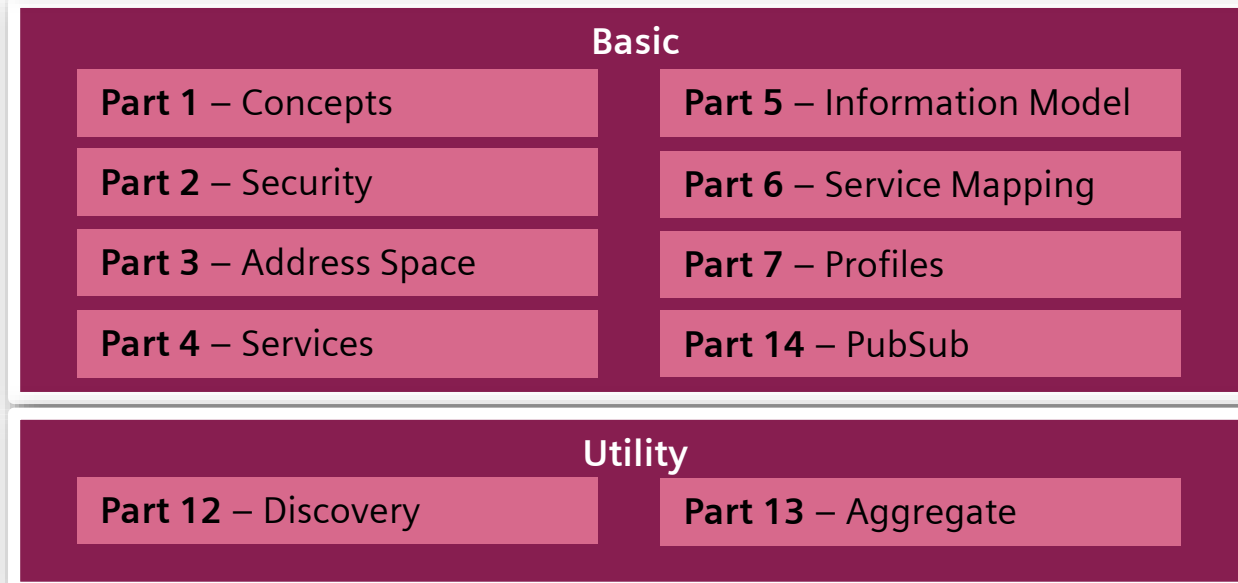
Advantages on the control and field levels

OPC UA Specification

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Information models

Companion Specifications

AutoID | Field Device Integration

Access types

Part 8 – Data Access | **Part 10** – Programs
Part 9 – Alarms and Conditions | **Part 11** – Historical Access

Infrastructure

Basic

Part 1 – Concepts | **Part 5** – Information Model
Part 2 – Security | **Part 6** – Service Mapping
Part 3 – Address Space | **Part 7** – Profiles
Part 4 – Services | **Part 14** – PubSub

Utility

Part 12 – Discovery | **Part 13** – Aggregate

Siemens Industry product portfolio
Classification of OPC UA servers

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Cloud

Manufacturing Execution System

SCADA system

Engineering framework

Energy management

Controller · HMI · IPC · Industrial communication · Motion control · CNC

Power supply and distribution · Industrial identification · Distributed I/O · Drive systems · Industrial controls

OPC UA

PROFINET
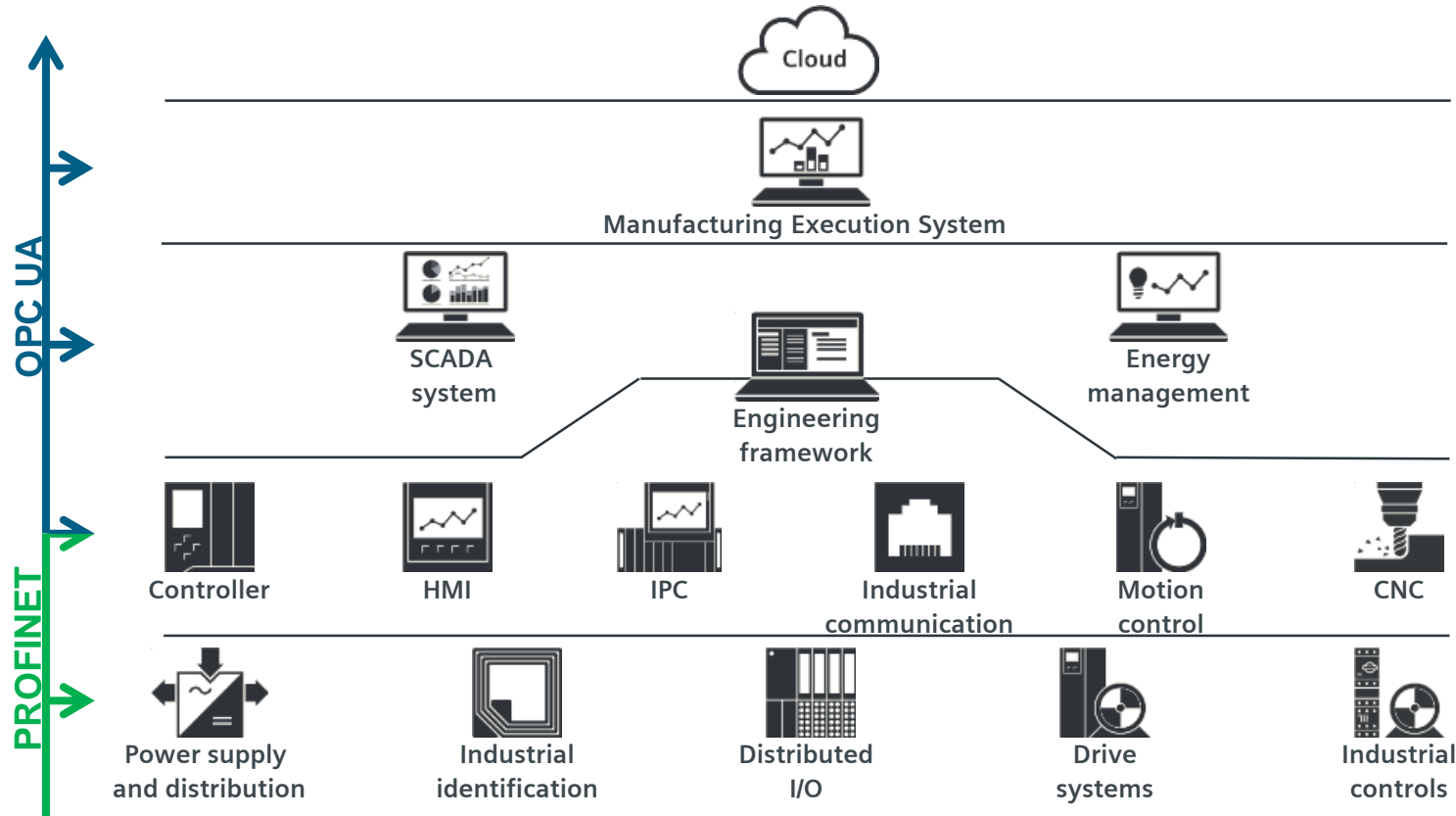
SIMATIC NET, WinCC RT Professional, WinCC V7.5, PCS 7, SINEMA Server, SINEC NMS, TeleControl Server Basic, SIMATIC Energy Manager PRO, WinCC OA

S7-1500, HMI Comfort/Mobile Panel, WinCC RT Advanced, S7-400 with CP 443-1, SIMOTION, SINUMERIK, CC7

RF600, RF18xC, PSU8600/UPS1600, SIMOCODE, 3RW44

Siemens Industry product portfolio
Classification of OPC UA clients

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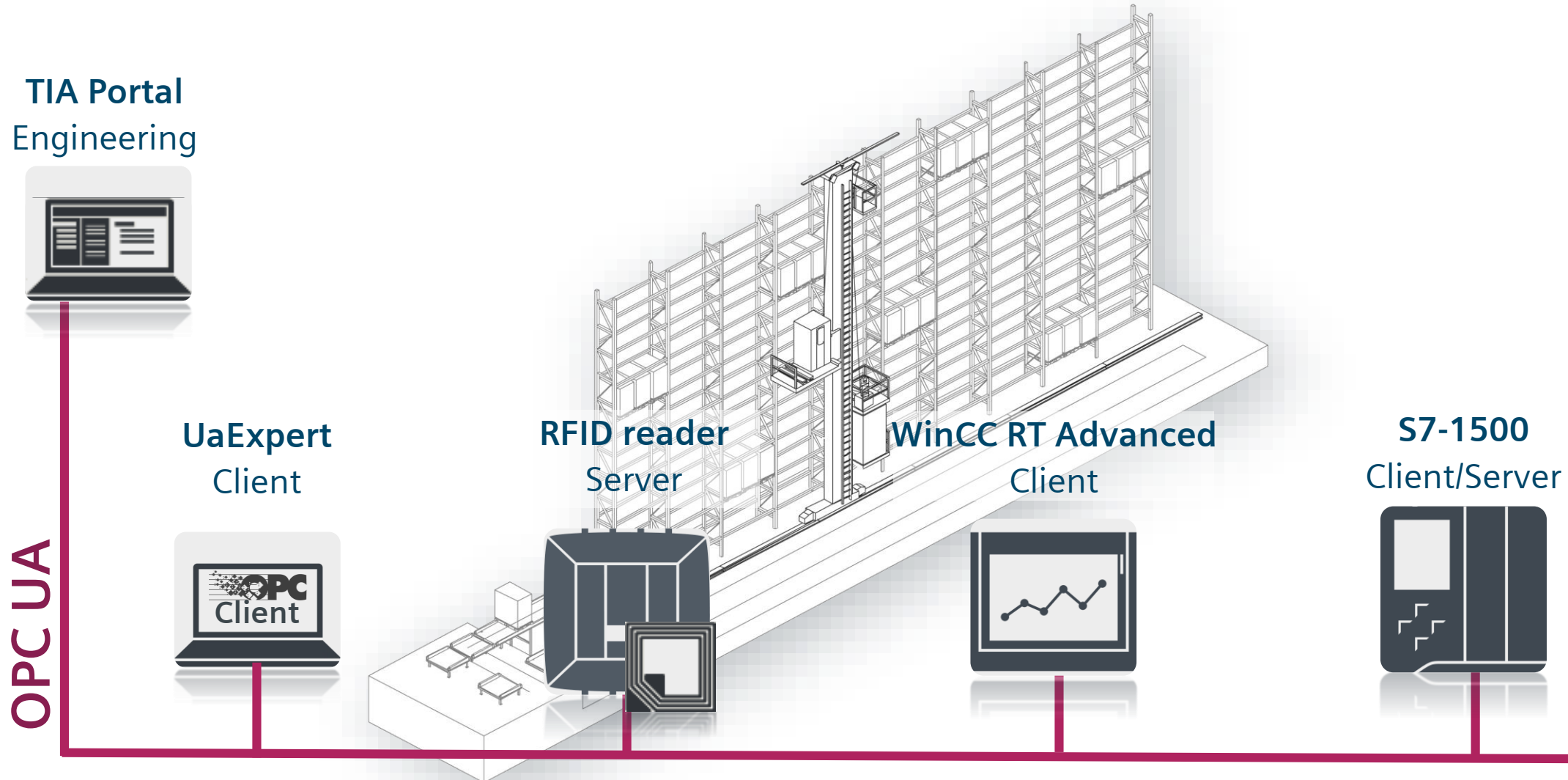*Ingenuity for life*
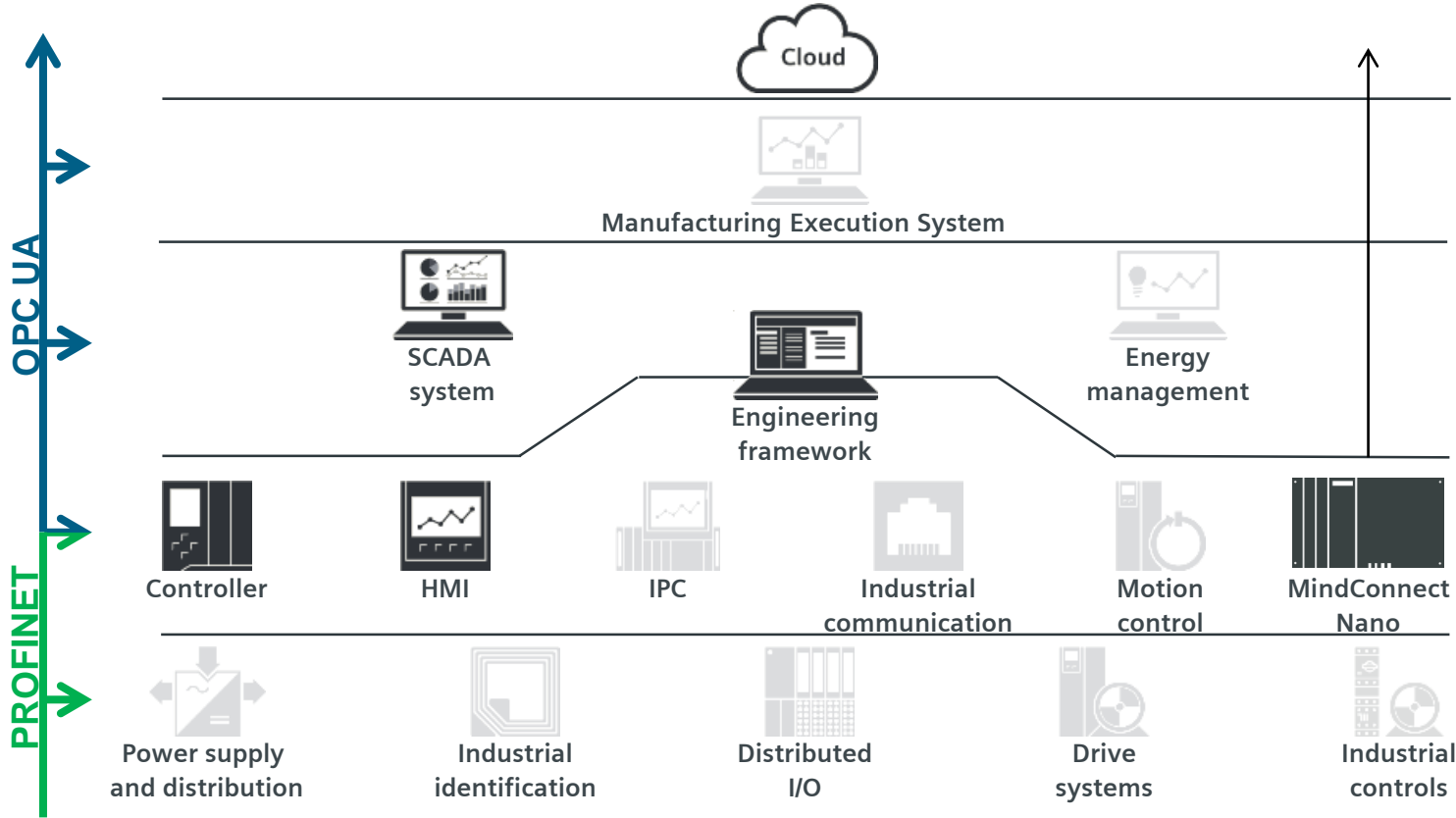
WinCC RT Professional, WinCC V7.5, WinCC OA

S7-1500, HMI Comfort/Mobile Panel, WinCC RT Advanced, MindConnect Nano, IOT2000, S7-400 with CP 443-1
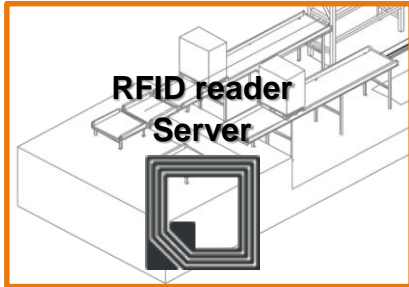
No client on field level

High bay racking exercise concept
Guideline for the practical exercises

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TIA Portal
Engineering

UaExpert
Client

RFID reader
Server

WinCC RT Advanced
Client

S7-1500
Client/Server

OPC UA

Exercise concept in detail

RFID reader Server

Receiving of packages

- Scanning of a package with the RFID reader
- Provision of the scanned package ID

S7-1500 Client & Server

Posting/management of the racking system

- Provision of variables and methods for evaluation and control of the racking system
- Reading of variables of the RFID reader
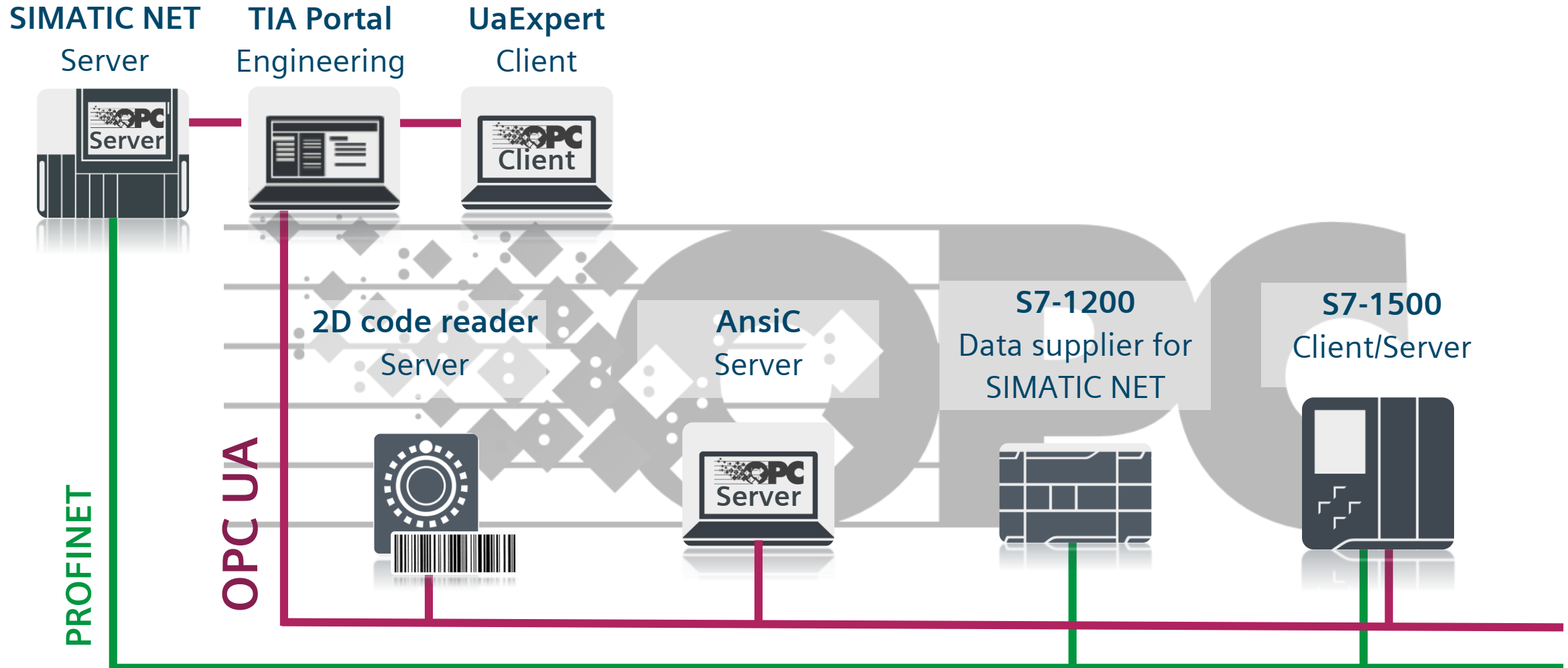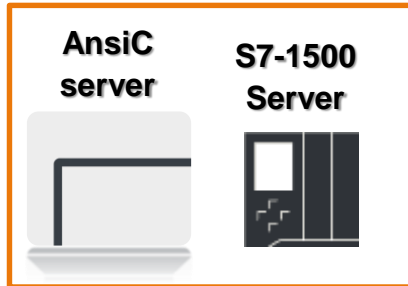- Call up of methods of the RFID reader

WinCC RT Advanced Client

Control and visualization of the process

- Reading/writing of variables of the S7-1500 from an HMI

Exercise concept in detail

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AnsiC server — S7-1500 Server

Basic OPC UA data exchange

- Establishing a connection
- Reading/writing of variables and historical data
- Call up of methods
- Becoming familiar with the address space

2D code reader Server

OPC UA server of a third-party device manufacturer

- Establishing a connection
- Controlling a sensor via OPC UA
- Becoming familiar with the Companion Specification

S7-1200 Data — SIMATIC NET SERVER
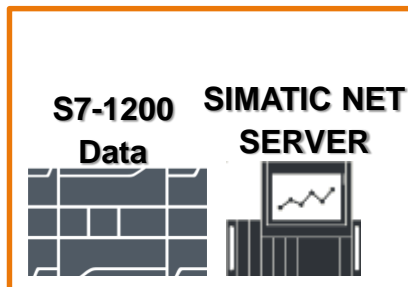
Connection of non-OPC-UA-capable devices and Alarms & Conditions

- Reading/writing of variables of the S7-1200 via SIMATIC NET Server
- Receiving of messages and events of S7-1500 via SIMATIC NET Server