

Ten years of OPC: From Data Access to Unified Architecture

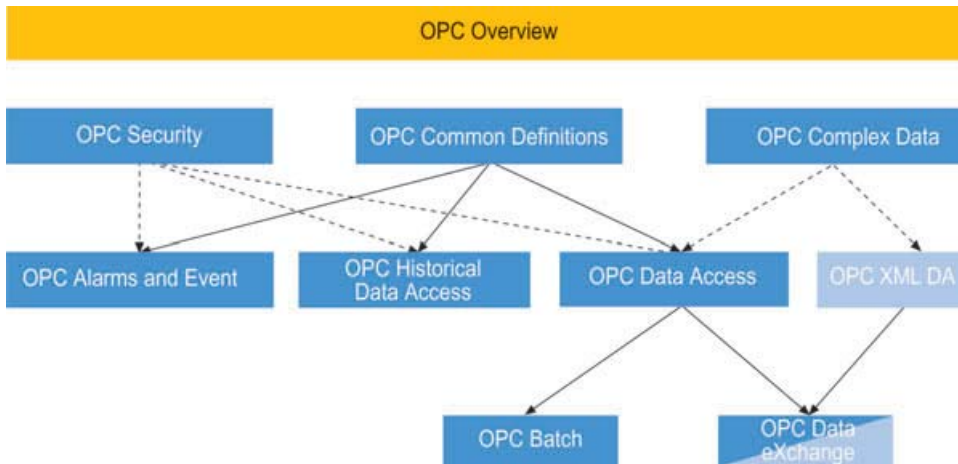


Image 1: Available OPC specifications

OPC was originally defined to connect PC-based applications to process peripherals in a standardized way. But since the creation of the platform-independent OPC UA specification at the latest, many more tasks can be handled using OPC.

The newly founded OPC Task Force met for the first time in May 1995. In December of the same year, the first draft specification of Data Access 1.0 was published. Now, just ten years later, OPC has developed into a worldwide standard for exchanging data and information between software components. OPC is no longer merely a substitute for proprietary communication drivers for connecting SCADA systems and visualization programs to process peripherals. Process control systems, PC-based controllers, MES and even ERP systems now also use OPC interfaces. The OPC interface is not just used to transfer process data or individual parameters. Instead, entire ERP documents, parameter sets, control sequences, video signals or drive programs can be transported via OPC.

Overview of the OPC status quo

Version 3.0 of OPC Data Access (DA) is already available. There are a number of other specifications as well, such as Alarms & Events (AE), Historical Data Access (HDA), Batch, Data eXchange (DX) and specifications which take industry- and task-specific issues into account. The roots of OPC are closely connected

to Microsoft's Windows operating system. The original meaning of OPC – "OLE for Process Control" – comes from Microsoft's OLE technology of the 1990s. OLE was soon replaced by the Component Object Model COM and Distributed COM. When the OPC Data eXchange and OPC XML DA specifications were drawn up, which expanded OPC to include XML and Web services, the original meaning of OPC no longer applied. OPC now stands for "Openness, Productivity and Collaboration". Instead of indicating a connection with a certain basic technology, the name now represents an open, interoperable and productive OPC interface. The "C" in OPC stands for "collaboration". This reflects the variety of cooperative partnerships the OPC Foundation has established with other standardization organizations, such as the Systems and Automation Society for ISA-88 (batch control standards), ISA-95 (enterprise integration standards), and



Image 2: OPC XML DA implementations already exist for Linux and other "non-Windows" operating systems.

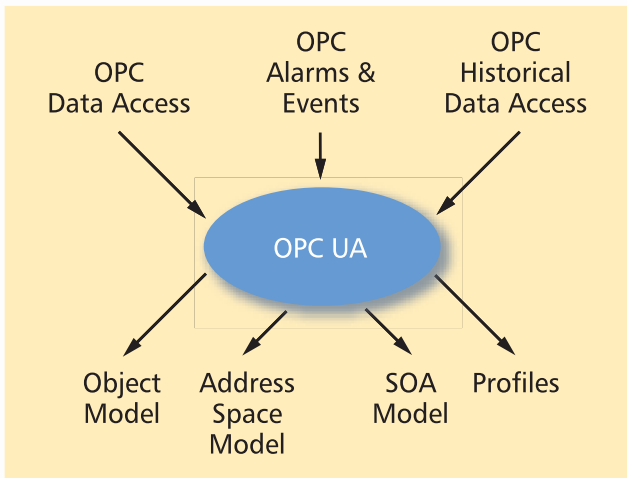


Image 3: OPC Unified Architecture makes it easier to combine OPC servers from various categories.

ISA-99 (security standards). The OPC Foundation also has an active partnership with SAP in Walldorf and with the Machinery Information Management Open Systems Alliance (MIMOSA), the International Electrotechnical Commission (IEC) and the Electronic Device Description Language (EDDL) working group of the three fieldbus organizations: the Profibus User Organization, the Fieldbus Foundation and the Hart Communication Foundation. When DCOM was its technological basis, OPC was restricted to the automation level and to Microsoft Windows platforms within a company network. The inclusion of Web services and XML removed this restriction so that data and information could remain isolated behind a company firewall while being opened up to cross-platform communication and the Internet. This has made it possible to realize the vision of global OPC interoperability and the migration to a standardized, open Internet architecture platform for information flowing from the factory floor to the company management.

The vision of global OPC interoperability

The further development and distribution of Internet technologies has opened up entirely new approaches and integration concepts. Remote maintenance and

operation is already being carried out in some branches of industry using conventional Web servers and standard Web browsers. Web services are becoming more and more popular. Web services are available on many different operating system platforms and are thus the ideal basis for cross-platform interaction between

software components. Without guidelines for defining Web service interfaces, however, there is a danger that proprietary – that is, vendor-dependent – implementations will grow out of control. This is where interface standardization by the OPC Foundation comes in. OPC already stands for vendor neutrality and independent communication protocols. On the basis of new technologies like XML, SOAP and Web services, the OPC Foundation has developed a vision of global interoperability – that is, the possibility of standardized interaction between software applications, regardless of who manufactured them, which programming language was used to develop them, which operating system they run on, or where they are located. OPC implementations on Linux and other "non-Windows" operating systems, which enable vendor- and platform-independent communication, have already been developed on the basis of the OPC XML DA specification.

OPC Unified Architecture

The OPC Foundation has been working on the new OPC Unified Architecture (UA) specification for one and a half years. OPC UA defines an interoperability platform and standardizes the use of various OPC servers and clients (DA, AE, HDA, ...) for the vertical and horizontal exchange of data. The OPC UA working

group is pursuing two goals:

1. To make it easier to combine existing OPC products from various categories (DA, AE, HDA) and
2. to expand the areas of application and the benefits of the individual OPC specifications.

It is important to make it easier to combine different OPC servers because, these days, DA, AE and HDA servers are increasingly encountered at the same time in projects. The OPC UA working group decided to develop a model which combines the various facets of the existing OPC specifications and which defines a set of services that are executed on a single, integrated data model. These services have capabilities which are similar to those of the existing OPC DA, AE and HDA interfaces, but they are standardized. The integrated data model should make it possible to combine several hierarchical namespaces to form a complete information or data pool. Furthermore, a standardized mechanism is being defined for locating and connecting all data sources (i.e., servers). The OPC Unified Architecture specification has the following main features:

- **Broad spectrum of application:**
With the COM specification, OPC was primarily limited to Microsoft Windows, and thus to desktop computers. Since OPC UA is based on Web services, it will be easier to use OPC UA in devices (SPS, control systems, DCS, ...). At the same time, OPC UA applications can also be used in high-end systems and control systems running on Unix and other operating systems.
- **Open communication:**
OPC UA uses the most recent Web services technology, including some of the latest WS standards. This gives OPC UA cross-platform capabilities, and it means that numerous tools are supported.
- **Integrated namespace and object model:**
All functions of the existing specifications can be implemented with the

basic services defined in OPC UA.

The variation in functionality is a product of the variety of data and not the variety of interface methods.

■ Use of the Web services standard:

OPC UA uses large sections of the Web Services Interoperability (WS-I) standards. One WS-I standard, known as WS-Policy, enables OPC UA clients and servers to negotiate at runtime which protocols and coding are to be supported. This ensures the best possible communication while guaranteeing the highest degree of interoperability. OPC UA also uses another WS-I standard, WS-Eventing, to support real call-back functions as used in COM interfaces, as well as "polled refresh", which was introduced with XML DA.

■ Performance:

OPC UA also focuses on the need for performance and scalability in that parts of the basic services use binary encryption in the Web services model. OPC UA thus enables applications with throughput performance which is comparable to or even greater than that of OPC applications in a DCOM-based architecture. Image 4 explains how OPC DA, AE, HDA and the OPC Commands functionality are based on the OPC Unified Architecture basic services and how these basic services also form the foundation for further functionality which is needed in certain cases.

Outlook for OPC

The OPC UA working group has set very ambitious goals. Global interoperability will be achieved in several stages. It will not be a revolution, but an evolution. The path towards OPC UA starts with an OPC UA "wrapper" for integrating the installed basis of DA, AE, HDA and other servers with the first version of the specification. Investment security is the highest priority. Unified Architecture makes it possible for unprocessed raw

data – which is of interest to very few people outside of a factory – to be transformed into valuable information which can be used by managers, maintenance technicians, accountants, etc. OPC UA is therefore the link between the automation level and the company level, e.g., plant management and production control. The "component"-based approach of OPC will remain valid indefinitely, since more than 7,500 OPC products and several million installed systems will continue to be used. DCOM-based OPC products and Web service-based OPC UA products will co-exist in the coming years. DCOM-based OPC products will continue to be developed for process-related fields. These will increasingly be supplemented by OPC UA implementations for embedded uses and for the MES and ERP level. OPC UA wrappers will allow the new OPC UA components to be combined with the installed basis of DCOM-based OPC products, which will continue to grow. It will therefore be possible to transform the data from existing products – which was previously only used within company networks – into information which can be made available beyond the boundaries of firewalls. In the future, manufacturers will still use toolkits to implement OPC components. The architecture and implementation of such toolkits must allow manufacturers to smoothly migrate their developed components to the Web-service-based OPC UA world of the future. For this reason, the OPC Toolbox from Softing supports DA, AE, HDA and DX, as well as the XML- and Web-services-based approach. Softing OPC products are already enabling communication over the Internet, as set out in the UA specification. The first OPC servers running on Linux and developed on the basis of the Softing XML DA toolkits are already in industrial use. Compatible UA products are being planned. Starting in fall 2005, Softing will offer the first OPC UA seminars for manufacturers. ■



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